



Field Indicators for Identifying

Hydric Soils

In New England

Version 2
July 1998

***Field
Indicators
for Identifying
Hydric Soils
in New England***

***Version 2
July 1998***

Acknowledgements

This manual reflects the collective effort and vision of the New England Hydric Soils Technical Committee. The Committee consists of soil scientists, wetland scientists, and regulatory authorities. Its twenty-two members represent the private sector, universities, organizations, societies, and state, local, and federal governments. We want to express our appreciation to these individuals and to all others who participated in the development and review of this manual.

Special thanks go to the staff of the New England Interstate Water Pollution Control Commission (NEIWPCC) for producing and distributing this manual; to EPA-New England for funding the production and distribution; and to staff from the U.S. Army Corps of Engineers, New England Division, Visual Information Branch, for developing the illustrations.

Although this revised publication of *Field Indicators for Identifying Hydric Soils in New England* reflects current science and is representative of hydric soil morphologies in the region, the Technical Committee recognizes that this manual will undergo continuous field review and testing which will likely require future revisions.

Comments on this manual should be sent to:
NEIWPCC Wetlands Workgroup
255 Ballardvale St., Wilmington, MA 01887
phone: 978/658-0500

The New England Hydric Soils Technical Committee (NEHSTC) consists of the following members:

Peter Fletcher (Chair), USDA - Natural Resources Conservation Service

Stephen Gourley, USDA - Natural Resources Conservation Service

James Gove, Gove Environmental Services

Peter Hammen, New Hampshire Dept. of Environmental Services

Wayne Hoar, USDA - Natural Resources Conservation Service

Joseph Homer, USDA - Natural Resources Conservation Service

Steven Hundley, USDA - Natural Resources Conservation Service

Dr. Kenneth Kettenring, New Hampshire Dept. of Environmental Services

George Loomis, University of Rhode Island

Scott Lussier, New England Interstate Water Pollution Control Commission

Wende Mahaney, US Fish and Wildlife Service

David Marceau, Maine Association of Professional Soil Scientists

Thomas Peragallo, Northeast Land Consultants

Sidney Pilgrim, University of New Hampshire

David Rocque, Maine Dept. of Agriculture, Food and Rural Resources

Matthew Schweisberg, US Environmental Protection Agency

Michael Sheehan, US Army Corps of Engineers

Frank Smigelski, Federal Aviation Administration

Lori Sommer, New Hampshire Dept. of Environmental Services

Steven Tessitore, Connecticut Dept. of Environmental Protection

Dr. Peter Veneman, University of Massachusetts, Amherst

Dr. William Wright, University of Rhode Island

Technical assistance and review were provided by:

Michael Whited, Chair, National Technical Committee for Hydric Soils

Wade Hurt, NRCS National Leader for Hydric Soils

Leander Brown, NRCS Soil/Wetland Scientist

This manual should be cited as follows:

New England Hydric Soils Technical Committee. 1998, 2nd ed., *Field Indicators for Identifying Hydric Soils in New England*, New England Interstate Water Pollution Control Commission. Wilmington, MA. p. 76

Table of Contents

Introduction	1-2
Regional Indicators For Hydric Soils	2-4
How To Use This Manual	4 - 6
References	7
Key to Hydric Soil Indicators	8 - 12
Diagrams of Soil Profiles of Field Indicators	13 - 50
Appendix	51 - 59
Chart for Estimating Percent Redoximorphic Features	52
Chart for Estimating Size of Redoximorphic Features	53
Table for Estimating Contrast of Redoximorphic Features	54
Chart for Estimating Contrast of Redoximorphic Features	55
Chart for Determining Type of Soil Structure	56
Table for Estimating Grade of Soil Structure	57
Chart for Estimating Size of Granular Structure	58
Chart for Estimating Size of Blocky Structure	59
Glossary	60 - 72
Notes	73 - 76

Introduction

In the mid-1980s, staff from the New England Division of the Army Corps of Engineers, with technical assistance provided by the United States Department of Agriculture (USDA) Natural Resources Conservation Service (then the Soil Conservation Service), began developing New England-wide soil drainage class criteria to make field identification of hydric soils easier and more standardized. Several years of exhaustive field testing were conducted, involving a myriad of consulting firms, academic experts, professional societies, and federal, state, and local agencies.

Over the years, the soil drainage class criteria were revised many times as the knowledge base and experience grew. To gather data and obtain opinions, detailed questionnaires were circulated to soil scientists, wetland ecologists, and others in regulatory agencies, private consulting firms, and universities. Despite significant improvements, the criteria for the drainage classes were still confusing at times, and some of the region's soil scientists had reservations about using them.

In 1992, spurred on by an attempt at the federal level to develop field indicators of hydric soils on a nationwide basis, a group of federal, state, private and academic experts in wetland and soil sciences (many of the same individuals from the earlier effort) convened to develop regional field indicators for identifying hydric soils in New England. Numerous drafts were produced, circulated for review, revised, and recirculated. The proposed field indicators were tested in northern and southern New England by a variety of soil scientists and by others in the wetlands profession. This manual is the culmination of those efforts.

Since the release of Version I, the New England Hydric Soils Technical Committee and representatives from the National Technical Committee for Hydric Soils (NTCHS) have had joint meetings and field trips to develop consistency between the New England and National Indicators. Version 2 of *Field Indicators for Identifying Hydric Soils in New England* includes revisions in

terminology and additional clarification of indicators, which increases consistency. Likewise, the NTCHS is considering revisions to the National Indicators that will better reflect hydric *soil morphologies* indicative of the New England Region.

This guide makes it easier for field personnel to identify and document hydric soils and their boundaries. These field indicators provide consistent and reliable evidence as to whether a certain soil meets the definition of hydric soil. To correctly interpret and apply this guide, however, users must have practical experience and a working knowledge of soils. When properly applied, this field guide yields results that are consistent with the identification of hydric soils as per the *1987 Army Corps of Engineers Wetland Delineation Manual*.

Finally, while this field guide is the culmination of nearly ten years of work, it is by no means a final product. Practical application, experience and continuing academic research will bear sufficient reason to periodically revise and update the field guide. No doubt, most of the supporting documentation for those revisions will come from you, the user.

Regional Indicators For Hydric Soils

A hydric soil is a soil that formed under conditions of saturation, flooding, or ponding long enough during the *growing season* to develop anaerobic conditions in the upper part (*Federal Register*, July 13, 1994). As a result of soil saturation and reducing conditions, hydric soils undergo chemical reactions and physical processes which differ from those found in upland soils. The field indicators of hydric soils contained within this guide are observable *soil morphologies* that have developed as a result of those chemical reactions and physical processes. Field indicators are also a historic record of yearly cycles of soil saturation and reduction which have been observed and documented by field soil scientists and validated through testing.

For many hydric soils, saturation and reduction in the upper part are seasonal and not continuous throughout the *growing season*. When the soil morphologies observed at a site meet the criteria for one of the New England field indicators for hydric soils, this is verification of *aquic conditions* in the *upper part of the soil* for *some period of time* during the *growing season*. Users are cautioned that when working in areas where the hydrology has been altered, the presence or absence of *redoximorphic features* may not reflect the current hydrologic conditions.

Many of the field indicators of hydric soil used in this manual are described as “*redoximorphic features*,” a term which replaces the previous terminology of “soil mottling” due to wetness. *Redoximorphic features* that are common to New England soils are grouped under two headings, “*redox concentrations*” and “*redox depletions*.”

Redox concentrations are bodies of apparent accumulation of iron and manganese (Fe/Mn) oxides that are the result of saturation and desaturation cycles in the soil. Soil features that represent *redox concentrations* of these two elements include:

- *Fe/Mn Nodules and Concretions*: firm to extremely firm irregularly-shaped bodies with diffuse boundaries.
- *Masses*: soft bodies, frequently within the matrix, whose shape is variable. Masses include features that formerly would have been called “reddish mottles.”
- *Pore Linings*: zones of accumulation that may be either coatings on a pore surface or impregnations of the matrix adjacent to the pore. *Strongly developed oxidized rhizospheres* are a form of *pore lining*.

Redox depletions are areas of soil with *low chroma colors* (≤ 2) having values of 4 or more where Fe/Mn oxides have been reduced and stripped out, due to prolonged saturation and associated reduction. These features have sometimes been called “gray mottles.”

In addition to *redoximorphic features*, other field indicators of hydric soils include: presence of hydrogen sulfide gas (rotten egg smell), organic soils (*Histosols*, except *Folists*), thick surface accumulations

of organic soil material (*histic epipedon*), organic streaking within the *E* horizon, and a thick dark *Bh* or *Bhs* horizon. Dark *A* or *Ap* horizons with values of 3 or less and chroma of 2 or less, when associated with other wetness morphologies, are also indicators of wetness.

References

1. National Technical Committee for Hydric Soils. June 1991. *Hydric Soils of The United States*. USDA, Soil Conservation Service, Miscellaneous Publication #1491.

How To Use This Manual

This key is specifically designed to address the hydric soil conditions common to New England and may not be applicable to other regions of the United States. Soils identified as hydric soils using this key meet the national requirements for hydric soils.

This key begins with soil conditions associated with the wettest soils—those with extended periods of saturation in the upper part and/or inundation. *Soil morphologies* developed under these conditions are clearly expressed and easily interpreted, and one *soil morphology* often allows the user to confidently make a decision. As the user progresses through this key, the soils have shorter periods of saturation in the upper part and the *soil morphologies* may not be as clearly expressed or easily identified. To avoid misinterpretation when evaluating these soils, this key requires the user to **identify a combination of *soil morphologies* observed within specified depths.**

Because of the unique *soil morphologies* associated with *spodic horizons*, these are addressed separately in this key. In addition, some indicators are grouped by soil texture. To use this key properly, a user must start with Hydric Soil Indicator I and progress through the key systematically. If the soil conditions observed in the field match one of the hydric soil indicators, that soil is considered to be hydric.

This key was designed to be an easy-to-use field guide that would apply throughout the New England Region. With the myriad of soil conditions found in New England, it became evident early on that one key could not address all hydric soil conditions without becoming very complex and difficult to use. Hence, this key addresses soil conditions most commonly associated with hydric soils in New England. It also recognizes that there are “problem soils” that are either not identified using this key or that are identified but are non-hydric. A separate supplement to this manual is planned, which will contain both a regional map showing the approximate extent of problem soil areas and a list of reliable field indicators for them.


When documenting hydric soils in the field, according to recommended practices, test holes are dug to a depth of two feet or more using a tile spade. The soil conditions observed in the test hole are then described and documented using standards and terminology developed by the USDA. Depth measurements should be made from the *soil surface*, which may vary depending upon soil conditions. For *Histosols* and soils with *histic epipedons*, the reference point where measurements are taken from is the top of the *O horizon* that is at least slightly decomposed. For all other mineral soils, the reference point is the top of the mineral surface horizons. Soil conditions and features that need to be observed and documented in order to use this key effectively include:


- **Soil horizons and layers** - list the designation plus thickness and depth for each.
- **Soil texture** - distinguish between *organic* and *mineral soil material* and note the textural class, where appropriate.
- **Soil color** - list the Munsell Notation for both *matrix color* and, if present, *redoximorphic features*.
- **Redoximorphic features** - Describe each type and document their color, *abundance*, *size*, *contrast*, and location (e.g., *ped interiors*). Field identification of *redoximorphic features* is most reliable when their contrast is *distinct* or *prominent*, and their abundance is *common* to *many*. When features are *faint* and/or *few*, extra care and professional judgment should be exercised as to whether or not they are an indication of a hydric soil.

Terms or phrases italicized are defined in the **Glossary of Terms**

- **Soil structure** - describe type (shape), size, and grade.
- **Other soil features may be required depending upon the situation** (e.g., depth of rooting, soil consistence).

This manual includes a series of diagrams, which illustrate each hydric soil indicator. The scales on either side of the diagram show the reference point of measurement (0 point), and required depths to horizons and layers. Soil textures are depicted using contrasting patterns. Notes highlight important characteristics and morphologies. **Some features were difficult to show graphically and if there is a perceived difference in interpretation between the diagrams and narrative key, the narrative key takes precedence.**

 **User Notes** are a new addition to this manual (Version 2), and are shown on the page opposite the diagram and below the indicator that they refer to. Their purpose is to provide additional information which may help in identifying an indicator in the field, or to alert users to possible exceptions and/or situations where professional judgment may be needed. User Notes are identified by the symbol shown on the left.

 In addition to User Notes, soil features designated as **Field Testing Only** are *soil morphologies* which may be helpful when identifying field indicators, but users are cautioned that these features have not had the field testing needed to substantiate their reliability. People who have observed these soil features in the field should document their findings and forward them to the NEIWPCC Wetlands Group. Your active participation is greatly appreciated and will improve and strengthen this manual. Field Testing Only criteria are depicted by the symbol shown on the left.

This manual also includes a **Glossary of Terms**. The terms included in the Glossary are italicized throughout the narrative text. Some definitions have been simplified to facilitate a field interpretation. Users who want complete definitions should refer to the references cited.

Please note that this manual does not address all hydric soil conditions found in New England, and professional judgment by a qualified individual is needed in unusual or problem soil areas.

References

Federal Register. February 24, 1995. *Hydric Soils of the United States*. Washington, DC (current *Hydric Soil Criteria*).

Federal Register. July 13, 1994. *Changes in Hydric Soils of the United States*. Washington, DC (current *Hydric Soil Definition*).

Glossary of Soil Science Terms. 1997. Soil Science Society of America, Madison, WI.

Tiner, R.W., Jr., and P.L.M. Veneman. 1995. *Hydric Soils of New England*. University of Massachusetts Extension, Revised Bulletin C-183R, Amherst, MA.

US Department of Agriculture, Natural Resources Conservation Service. 1996. G.W. Hurt, Whited, P.M., and Brindle, R.F. (eds). *Field Indicators of Hydric Soils in the United States*. USDA, NRCS, Fort Worth, TX.

US Department of Agriculture, Soil Survey Staff. 1996. *Keys to Soil Taxonomy*, Seventh Edition. US Government Printing Office, Washington, DC.






US Department of Agriculture, Soil Survey Division Staff. 1993. *Soil Survey Manual*. USDA Agricultural Handbook 18 (revised). US Government Printing Office, Washington, DC.

US Department of Agriculture, Soil Survey Staff. 1996. *National Soil Survey Handbook*. USDA, Natural Resources Conservation Service, US Government Printing Office, Washington, DC.

Vepraskas, M.J. 1996. *Redoximorphic Features for Identifying Aquic Conditions*. Technical Bulletin 301. North Carolina Ag. Research Service, North Carolina State University, Raleigh, NC.

KEY TO HYDRIC SOIL INDICATORS

Version 2 - July 1998

- I.  Any soil that is *frequently ponded* or *flooded* for a *long* or *very long* duration during the *growing season*; or . . . 14 - 15
- II.  Soils that are *flooded* daily by tides and/or have *sulfidic materials* within 12 inches of the *soil surface*; or 16 - 17
- III. Soils that have *aquic conditions* within the *upper part of the soil* for *some period of time* in most years, and
- A.  Have *organic soil materials* at or near the *soil surface* that are greater than 16 inches thick (i.e., *Histosols*);**
or 18 - 19
- B.  Have a layer of *organic soil materials* at or near the *soil surface* that is 8 to 16 inches thick (i.e., *histic epipedon*); and directly underlying the *O horizon* or, if present, the *A horizon*, have a *depleted* or *gleyed matrix* and/or other *redoximorphic features*; or 20 - 21
- C.  Have a layer 4 to 8 inches thick of *partially to well-decomposed (hemic and/or sapric) organic soil material* and/or a *mucky A* or *Ap horizon*, and are *directly underlain* by a horizon with a *depleted* or *gleyed matrix*; or 22 - 23
- D. Within 10 inches of the top of the *mineral soil material* and directly underlying an *A* or *Ap horizon* (or, if they are not present, an *O horizon*), is a horizon with a *depleted* or *gleyed matrix* (for soils with *moderate to strong structure*, the *matrix color* is recorded for *ped interiors*); or. 24 - 25
- E. Beginning within 20 inches of the top of the *mineral soil material* and directly underlying a *thick* or *very thick, dark A*

***Folists* are excluded from Hydric Soil Indicator III.A.






User Note/Field Testing Only: refer to page opposite the diagram depicting this indicator.

Terms or phrases italicized are defined in the **Glossary of Terms**

or *Ap horizon* is a horizon with a *depleted* or *gleyed matrix* that is 4 inches or more thick (for soils with *moderate to strong structure*, the *matrix color* is recorded for *ped interiors*); or 26 - 27

F. Have a *spodic horizon* and one of the following morphologies:

1.  within 6 inches of the top of the *mineral soil material* have an *E horizon (eluvial horizon)* with 5 percent or more *redoximorphic features* and/or *organic streaking*, that is *directly underlain* by a *spodic horizon* with either:
 - a) a *Bs horizon* with *redoximorphic features* in the upper part; or 28 - 29
 - b) a *dark Bh* and/or *Bhs horizon* that is *directly underlain* by a horizon with *redoximorphic features* in the upper part; or 28 - 29
2.  beginning within 10 inches of the top of the *mineral soil material* and directly underlying a *dark A horizon* and/or a *shallow E horizon* (or if neither is present, an *O horizon*), there is a *dark Bh* and/or *Bhs horizon**** that is greater than 2 inches thick that is *directly underlain* by a horizon with 5 percent or more *redoximorphic features* in the upper part; or 30 - 31
3.  within 10 inches of the top of the *mineral soil material* and directly underlying a *dark Ap horizon*, is either:
 - a) an *E horizon* with 5 percent or more *redoximorphic features* and/or *organic streaking* *directly underlain* by a horizon with *redoximorphic features* in the upper part; or 32 - 33

***This morphology can develop as a result of wetness, or in the *cryic temperature regime*, as a result of climate. See Section IV for problem soil areas due to cold temperatures.



User Note/Field Testing Only: refer to page opposite the diagram depicting this indicator.


*Terms or phrases italicized are defined in the **Glossary of Terms***


b) a *dark Bh* and/or *Bhs* horizon that is *directly underlain* by a horizon with 5 percent or more *redoximorphic features* in the upper part; or 32 - 33

c) a *Bs* horizon with 5 percent or more *redoximorphic features* in the upper part. 32 - 33

G. Do not have a *spodic horizon* and the *dominant textures* in the *upper 20 inches* of the soil are *loamy fine sand* or *coarser* and:

1. have a layer 4 to 8 inches thick of *partially to well-decomposed (hemic and/or sapric) organic soil material* and/or a *mucky A* or *Ap* horizon; and are *directly underlain* by a horizon with 5 percent or more *redoximorphic features*; or 34 - 35

2.  within 10 inches of the top of the *mineral soil material* and directly underlying a *dark A* or *Ap* horizon (or, if they are not present, an *O* horizon) is a horizon with a *matrix color* due to wetness of chroma 3 or less, value 4 or more, with 5 percent or more *redoximorphic features*; or 36 - 37

3.  within 15 inches of the top of the *mineral soil material* and directly underlying a *thick, very dark Ap* horizon there is a horizon with a *matrix color* due to wetness of chroma 3 or less, value 4 or more, with 5 percent or more *redoximorphic features*. 38 - 39


H. Do not have a *spodic horizon* and the *dominant textures* in the *upper 20 inches* of soil are *finer than loamy fine sand*, and

1. within 10 inches of the top of the *mineral soil material* and directly underlying a *dark A* or *Ap* horizon (or, if they are not present, an *O* horizon) is a horizon with 10 percent or more *redox depletions*, and within 20 inches of



User Note/Field Testing Only: refer to page opposite the diagram depicting this indicator.

Terms or phrases italicized are defined in the **Glossary of Terms**

- the *mineral soil surface* there is a horizon with a *depleted* or *gleyed matrix* (for soils with *moderate to strong structure*, the *matrix color* and percent *redox depletions* are recorded for *ped interiors*); or. 40 - 41
2. within 15 inches of the top of the *mineral soil material* and directly underlying a *thick, very dark Ap horizon*, is a horizon with either:
 - a) 20 percent or more *redox depletions* and within 20 inches of the *mineral soil surface* there is a horizon with a *depleted* or *gleyed matrix* (for soils with *moderate to strong structure*, the *matrix color* and percent *redox depletions* are recorded for *ped interiors*); or 42 - 43
 - b) 10 percent or more *redox depletions* and within 20 inches of the *mineral soil surface* there is a horizon with a *depleted* or *gleyed matrix*, and there are 5 percent or more *redoximorphic features* within 6 inches of the top of the *mineral soil material* (for soils with *moderate to strong structure*, the *matrix color* and percent *redox depletions* are recorded for *ped interiors*) 44 - 45
 - I. Any soil that has a *very dark A* or *Ap horizon* less than 10 inches thick (or, if they are not present, an *O horizon*) that is *directly underlain* by a horizon with a *matrix color* due to wetness of chroma 3 or less, with 10 percent or more *redoximorphic features*; and within 24 inches of the *mineral soil surface* has *redox depletions*; and within 6 inches of the *mineral soil surface* has:
 1. 5 percent or more *redox concentrations* and/or *depletions*, and/or 46 - 47
 2.  2 percent or more *Fe/Mn nodules* and/or *concretions* 48 - 49



User Note/Field Testing Only: refer to page opposite the diagram depicting this indicator.

*Terms or phrases italicized are defined in the **Glossary of Terms***

- IV. Problem soil areas, disturbed and/or altered sites: Not all hydric soils are identified using the morphological indicators contained within this manual. Some soils within the New England Region have developed within mineral *parent materials* that mask or inhibit the development of *soil morphologies*. In other soils, the *parent materials* have been deposited recently, disturbed and/or altered and there has not been sufficient time for morphologies to develop. Problem soil areas recognized in New England include, but are not limited to: soils developed in Triassic red sandstones, carboniferous schists, strongly calcareous sediments, recently deposited alluvial sediments, some soils adjacent to brackish and salt water bodies, and soils within the *cryic temperature regime* of northern New England. We recognize the need to identify the general locations of these unique soils and to develop reliable field indicators for identifying hydric soils within them. 50

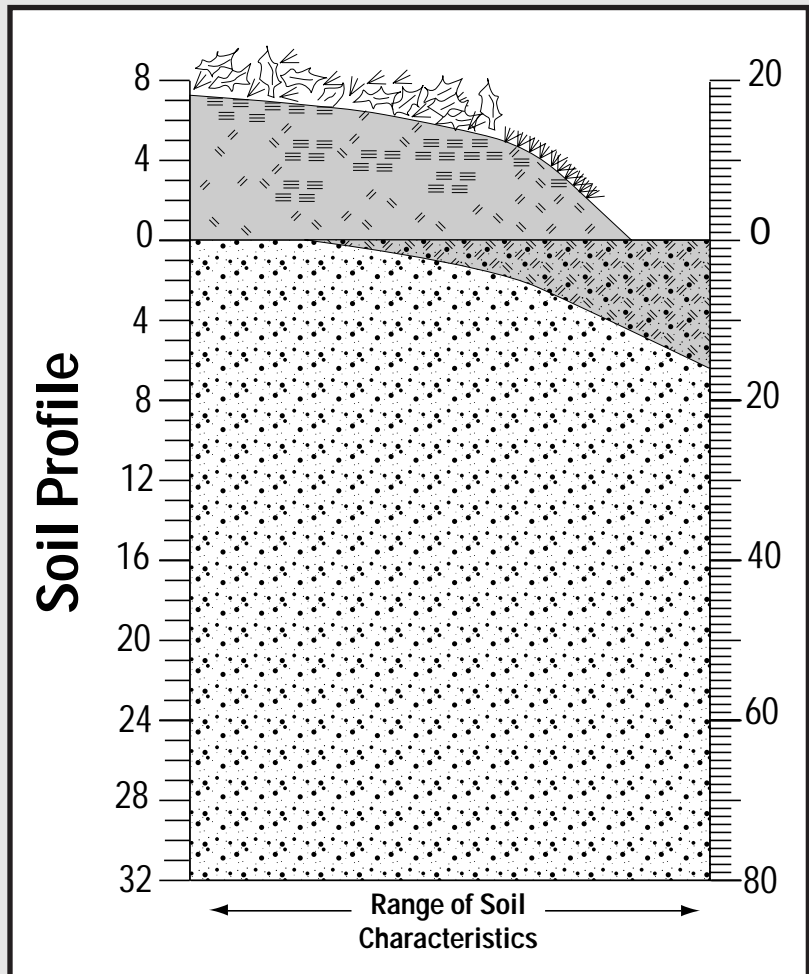


User Note/Field Testing Only: refer to page opposite the diagram depicting this indicator.

*Terms or phrases italicized are defined in the **Glossary of Terms***

Diagrams of Soil Profiles of Field Indicators

***Version 2
July 1998***



- I. Any soil that is *frequently ponded or flooded* for a *long or very long duration* during the *growing season*; or**



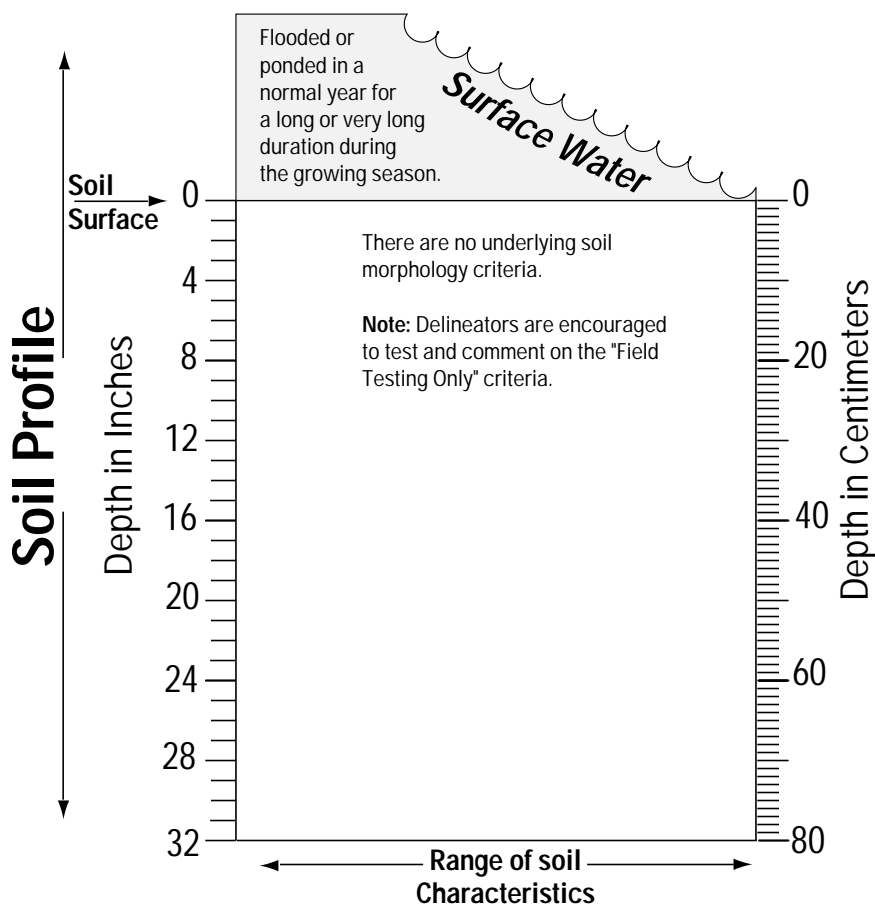
USER NOTE: Landscape position is a critical element when assessing an area for its susceptibility to, and frequency of, flooding or ponding. Landforms that are prone to flooding or ponding include, but are not limited to: floodplains, meander scars, backswamps, oxbows and closed depressions.









FIELD TESTING ONLY: After verification of landscape position, *soil morphologies* that indicate *long* and *very long durations* of flooding or ponding include, but are not limited to:

1. 5% or more *redoximorphic features* within the upper 6 inches of the *soil surface*; or
2. stratified layers starting within the upper 6 inches of the soil surface with one or more of the layers being either *very dark*, or *organic soil material* and/or *mucky mineral material*; and within 12 inches of the soil surface there is a layer with a *depleted* or *gleyed matrix*.

Hydric Soil Indicator I.



Key for Soil Textures

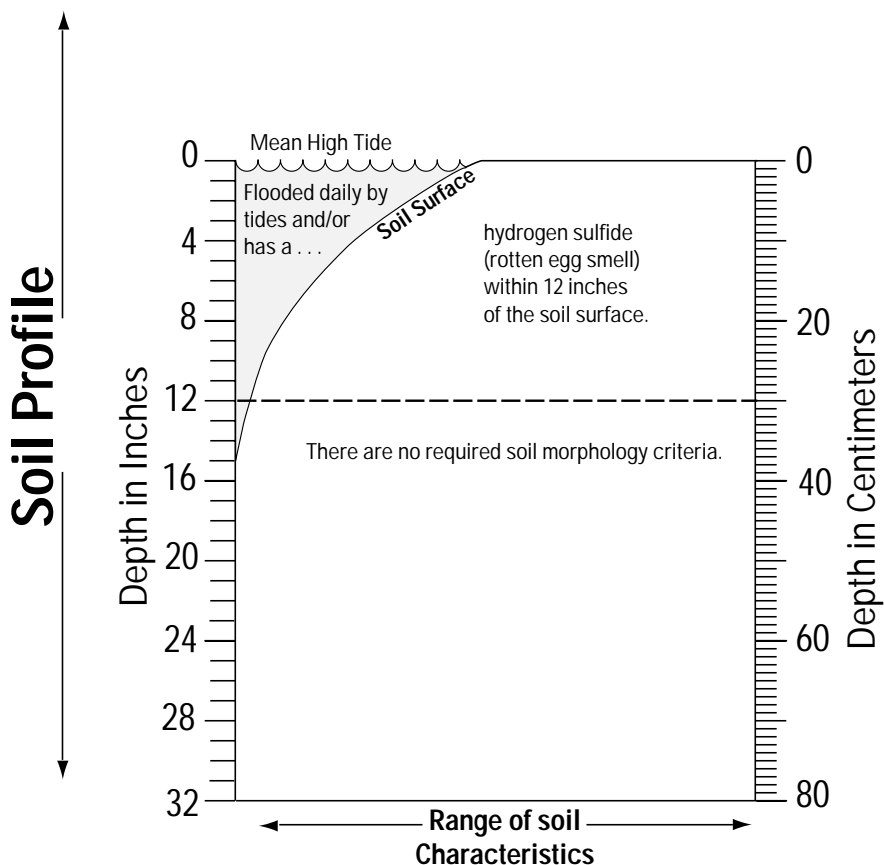
 Partially decomposed organic matter	 Mucky mineral soil	 Dominant textures finer than loamy fine sand
 Well decomposed organic matter	 Dominant textures loamy fine sand or coarser	 Any mineral soil texture

II. Soils that are *flooded* daily by tides and/or have *sulfidic materials* within 12 inches of the *soil surface*; or









USER NOTE: The presence of hydrogen sulfide gas (rotten egg smell) indicates the presence of *sulfidic materials*.

Hydric Soil Indicator II.



Key for Soil Textures

	Partially decomposed organic matter		Mucky mineral soil		Dominant textures finer than loamy fine sand
	Well decomposed organic matter		Dominant textures loamy fine sand or coarser		Any mineral soil texture

III. Soils that have *aquic conditions* within the upper part of the soil for some period of time in most years; and

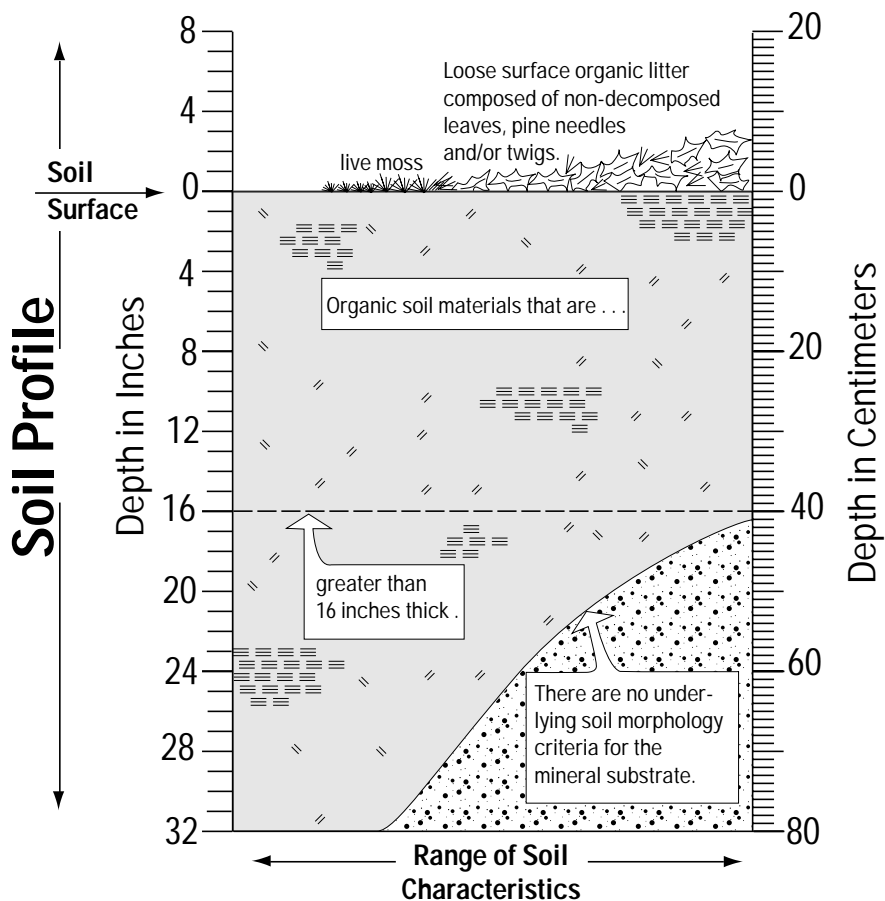
A. Have *organic soil materials* at or near the soil surface that are greater than 16 inches thick (i.e., *Histosols*); or**









USER NOTE: Within frigid and *cryic soil temperature regimes* and typically associated with areas having climatic conditions that favor the accumulation of organic material (e.g. maritime influence or high elevation), there are organic soils (i.e., *Folists*) that are never saturated with water except for a few days following heavy rains. Soils having these conditions are not hydric.

**** *Folists* are excluded from Hydric Soil Indicator III.A.**

Hydric Soil Indicator III. A.



Key for Soil Textures

 Partially decomposed organic matter	 Mucky mineral soil	 Dominant textures finer than loamy fine sand
 Well decomposed organic matter	 Dominant textures loamy fine sand or coarser	 Any mineral soil texture

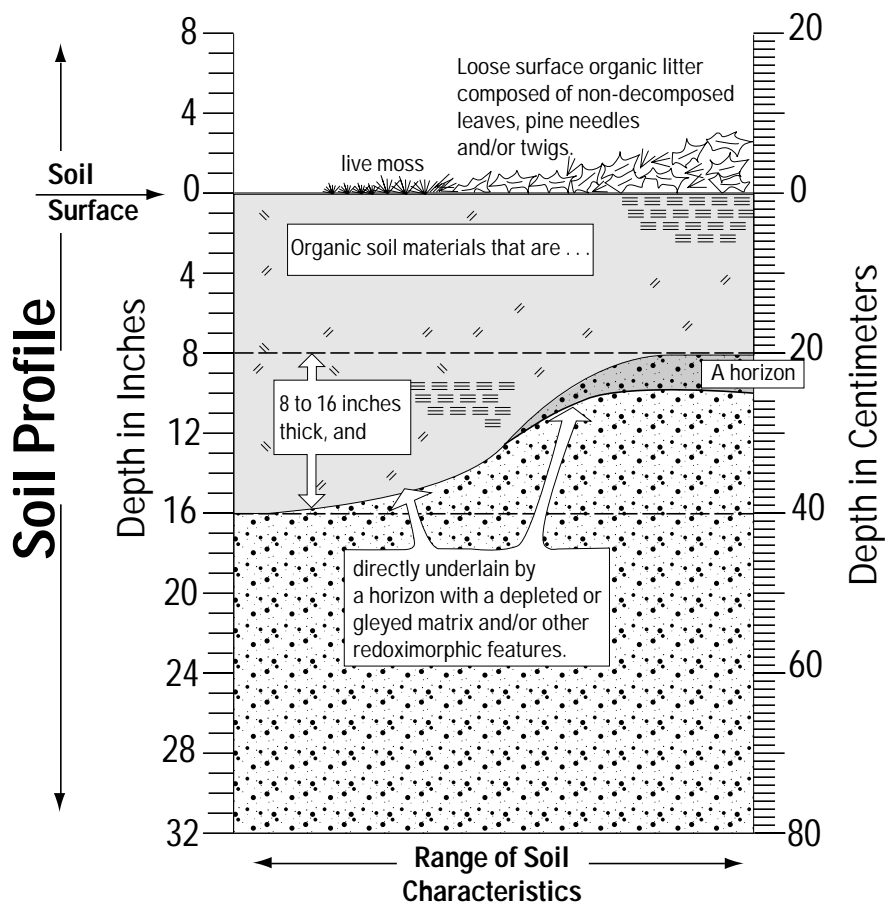
III. Soils that have *aquic conditions* within the upper part of the soil for some period of time in most years; and

B. Have a layer of *organic soil materials* at or near the *soil surface* that is 8 to 16 inches thick (i.e., *histic epipedon*); and directly underlying the *O horizon* or, if present, the *A horizon*, have a *depleted or gleyed matrix* and/or other *redoximorphic features*; or









USER NOTE: Within frigid and *cryic soil temperature regimes* and typically associated with areas having climatic conditions that favor the accumulation of organic material (e.g. maritime influence or high elevation), some soils have developed thick organic surface horizons (8 to 16 inches thick) that are never saturated with water except for a few days following heavy rains. When these soil conditions exist, the reference point (0) for depth measurements from the *soil surface* is the top of the *mineral soil horizons*.

Hydric Soil Indicator III. B.



Key for Soil Textures

 Partially decomposed organic matter	 Mucky mineral soil	 Dominant textures finer than loamy fine sand
 Well decomposed organic matter	 Dominant textures loamy fine sand or coarser	 Any mineral soil texture

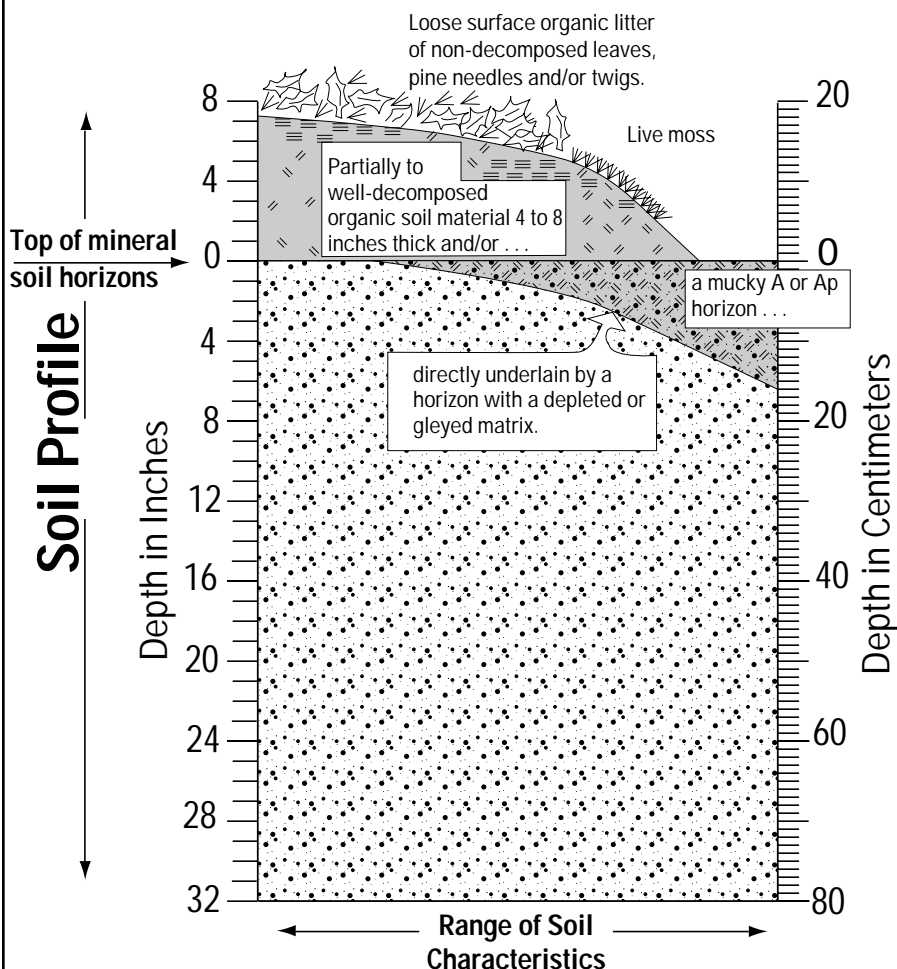
III. Soils that have *aquic conditions* within the upper part of the soil for some period of time in most years; and

C. Have a layer 4 to 8 inches thick of partially to well-decomposed (hemic and/or sapric) organic soil material and/or a mucky A or Ap horizon, and are directly underlain by a horizon with a depleted or gleyed matrix; or



USER NOTE: The characteristic *low chroma colors* of an *E horizon* are the result of an eluvial process and do not qualify as a *depleted* or *gleyed matrix*. For *E horizons* with *redoximorphic features*, refer to Indicators III.F.1. and III.F.3.

Hydric Soil Indicator III. C.



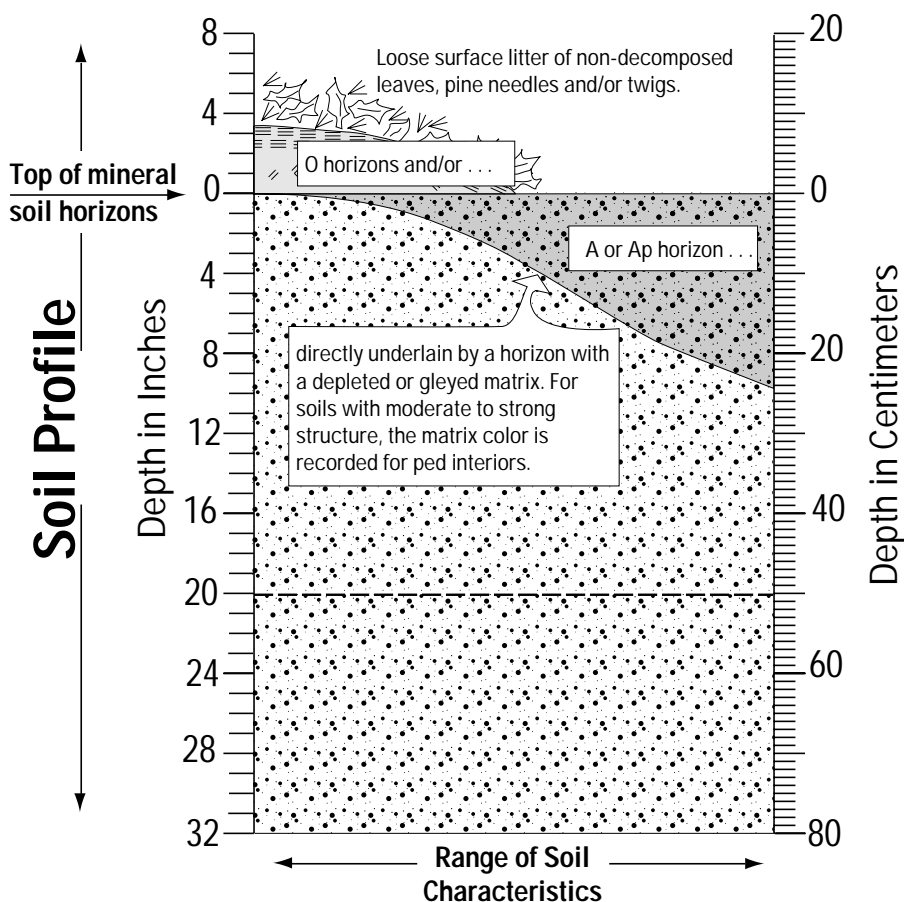
Key for Soil Textures

	Partially decomposed organic matter		Mucky mineral soil		Dominant textures finer than loamy fine sand
	Well decomposed organic matter		Dominant textures loamy fine sand or coarser		Any mineral soil texture







III. Soils that have *aquic conditions* within the upper part of the soil for some period of time in most years; and

D. Within 10 inches of the top of the *mineral soil material* and directly underlying an *A* or *Ap horizon* (or, if they are not present, an *O horizon*), is a horizon with a *depleted* or *gleyed matrix* (for soils with *moderate* to *strong structure*, the *matrix color* is recorded for *ped interiors*); or

Hydric Soil Indicator III. D.



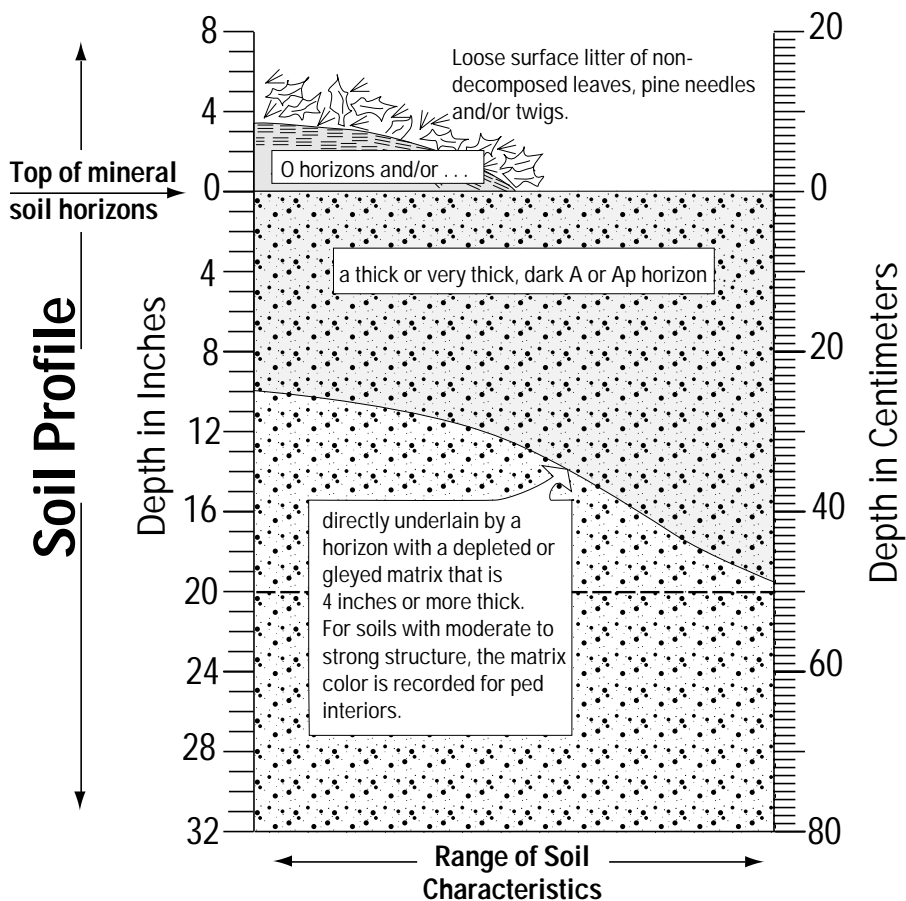
Key for Soil Textures

 Partially decomposed organic matter	 Mucky mineral soil	 Dominant textures finer than loamy fine sand
 Well decomposed organic matter	 Dominant textures loamy fine sand or coarser	 Any mineral soil texture







III. Soils that have *aquic conditions* within the upper part of the soil for some period of time in most years; and

E. Beginning within 20 inches of the top of the *mineral soil material* and directly underlying a *thick* or *very thick, dark A* or *Ap horizon* is a horizon with a *depleted* or *gleyed matrix* that is 4 inches or more thick (for soils with *moderate to strong structure*, the *matrix color* is recorded for *ped interiors*); or

Hydric Soil Indicator III. E.



Key for Soil Textures

 Partially decomposed organic matter	 Mucky mineral soil	 Dominant textures finer than loamy fine sand
 Well decomposed organic matter	 Dominant textures loamy fine sand or coarser	 Any mineral soil texture

III. Soils that have *aquic conditions* within the upper part of the soil for some period of time in most years; and

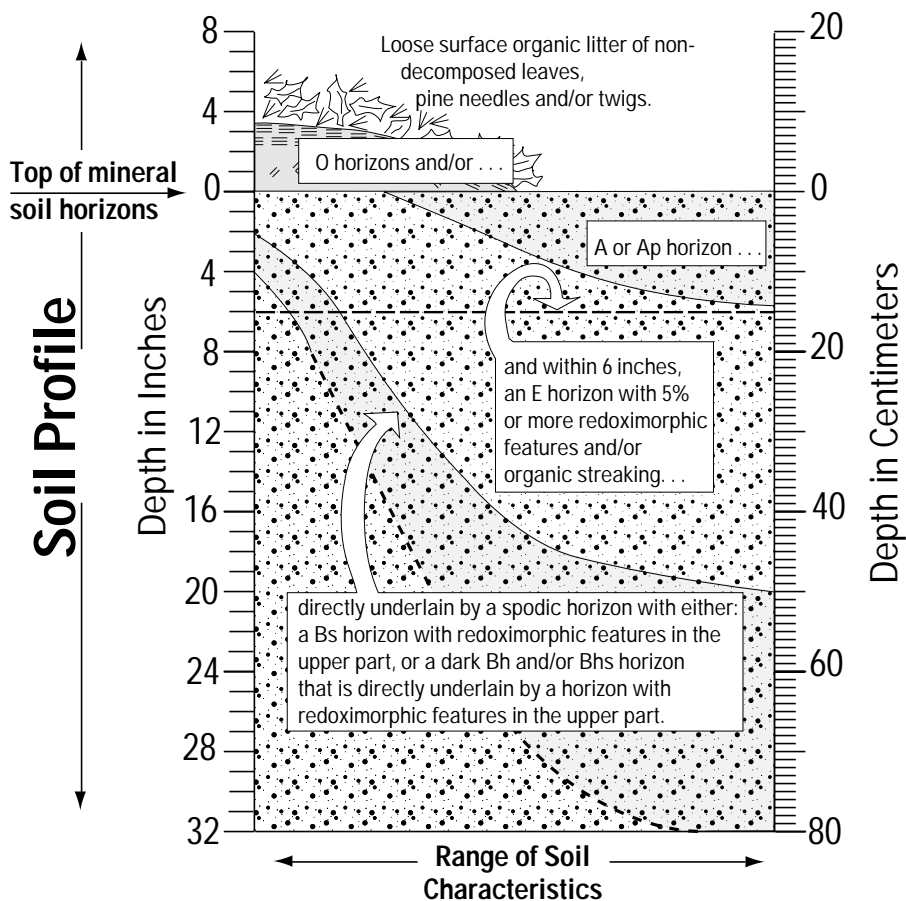
F. Have a *spodic horizon* and one of the following morphologies:

- 1. within 6 inches of the top of the mineral soil material have an *E horizon* (eluvial horizon) with 5 percent or more redoximorphic features and/or organic streaking, that is directly underlain by a *spodic horizon* with either:**
 - a) a *Bs horizon* with redoximorphic features in the upper part; or**
 - b) a *dark Bh* and/or *Bhs horizon* that is directly underlain by a horizon with redoximorphic features in the upper part; or**



USER NOTE: Soils with an *E horizon* that have dark brown to reddish brown colors in the horizon directly underlying it are considered to have evidence of spodic development. The *E horizon* is often discontinuous across the landscape because of natural disturbances. Some soils will have a *dark A* or *Ap horizon* overlying a dark brown to reddish brown *spodic horizon*. Not all soils that show evidence of spodic development will classify taxonomically as having a *spodic horizon*. These soils are considered problem soils and professional judgment by a qualified individual is recommended for interpreting their morphologies.

Hydric Soil Indicator III. F. 1.



Key for Soil Textures

	Partially decomposed organic matter		Mucky mineral soil		Dominant textures finer than loamy fine sand
	Well decomposed organic matter		Dominant textures loamy fine sand or coarser		Any mineral soil texture

III. Soils that have *aquic conditions* within the upper part of the soil for some period of time in most years; and

F. Have a *spodic horizon* and one of the following morphologies:

- 2. beginning within 10 inches of the top of the *mineral soil material* and directly underlying a *dark A horizon* and/or a *shallow E horizon* (or if neither is present, an *O horizon*), there is a *dark Bh* and/or *Bhs horizon**** that is greater than 2 inches thick that is *directly underlain* by a horizon with 5 percent or more *redoximorphic features* in the upper part; or**



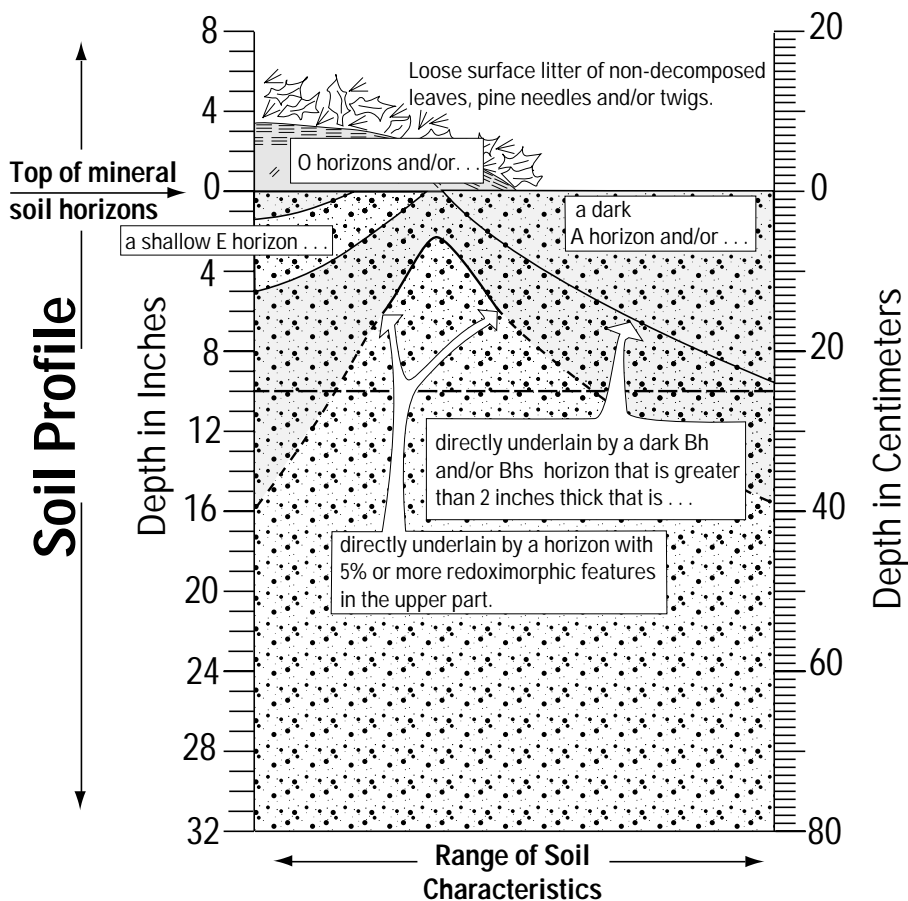
USER NOTE: Characteristically, in a natural forest setting, the *A horizon* is less than four inches thick.



USER NOTE: Soils with an *E horizon* that have dark brown to reddish brown colors in the horizon directly underlying it are considered to have evidence of spodic development. The *E horizon* is often discontinuous across the landscape because of natural disturbances. Some soils will have a *dark A* or *Ap horizon* overlying a dark brown to reddish brown *spodic horizon*. Not all soils that show evidence of spodic development will classify taxonomically as having a *spodic horizon*. These soils are considered problem soils and professional judgment by a qualified individual is recommended for interpreting their morphologies.

*****This morphology can develop as a result of wetness, or in the *cryic temperature regime*, as a result of climate. See Section IV for problem soil areas.**

Hydric Soil Indicator III. F. 2.



Key for Soil Textures

	Partially decomposed organic matter		Mucky mineral soil		Dominant textures finer than loamy fine sand
	Well decomposed organic matter		Dominant textures loamy fine sand or coarser		Any mineral soil texture

III. Soils that have *aquic conditions* within the upper part of the soil for some period of time in most years; and

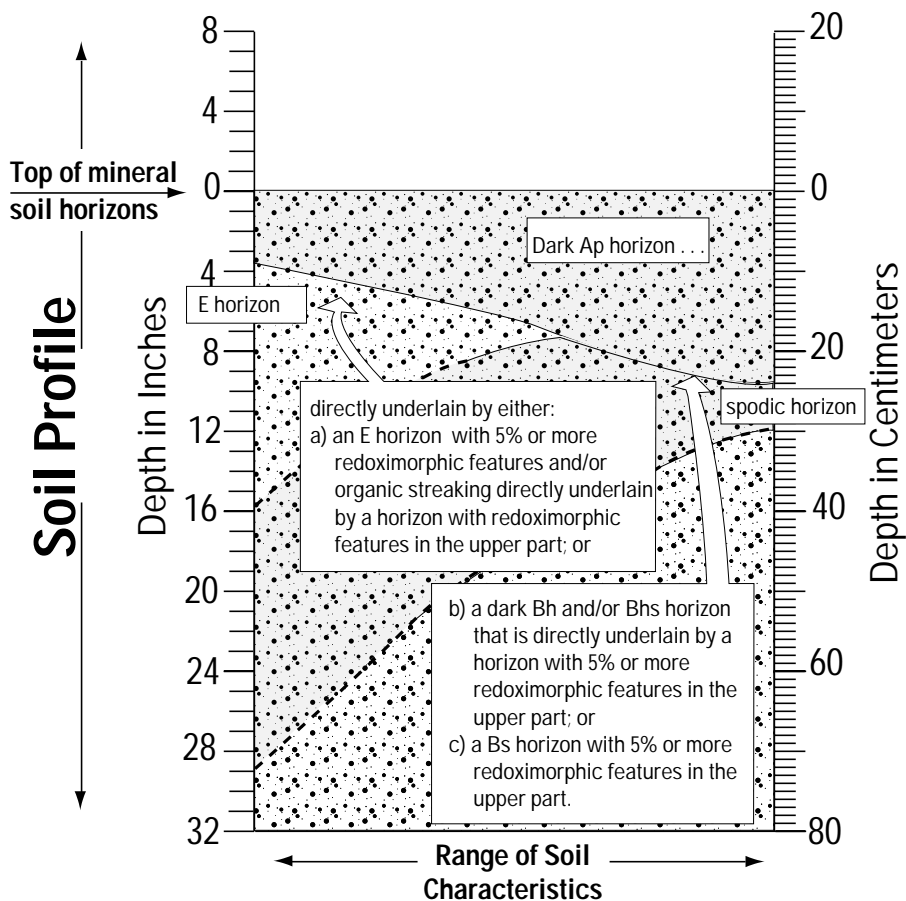
F. Have a *spodic horizon* and one of the following morphologies:

- 3. within 10 inches of the top of the *mineral soil material* and directly underlying a *dark Ap horizon*, is either:**
 - a) an *E horizon* with 5 percent or more *redoximorphic features* and/or *organic streaking* directly underlain by a horizon with *redoximorphic features* in the upper part; or**
 - b) a *dark Bh* and/or *Bhs horizon* that is *directly underlain* by a horizon with 5 percent or more *redoximorphic features* in the upper part; or**
 - c) a *Bs horizon* with 5 percent or more *redoximorphic features* in the upper part.**



USER NOTE: Soils with an *E horizon* that have dark brown to reddish brown colors in the horizon directly underlying it are considered to have evidence of spodic development. The *E horizon* is often discontinuous across the landscape because of natural disturbances. Some soils will have a *dark A* or *Ap horizon* overlying a dark brown to reddish brown *spodic horizon*. Not all soils that show evidence of spodic development will classify taxonomically as having a *spodic horizon*. These soils are considered problem soils and professional judgment by a qualified individual is recommended for interpreting their morphologies.

Hydric Soil Indicator III. F. 3.

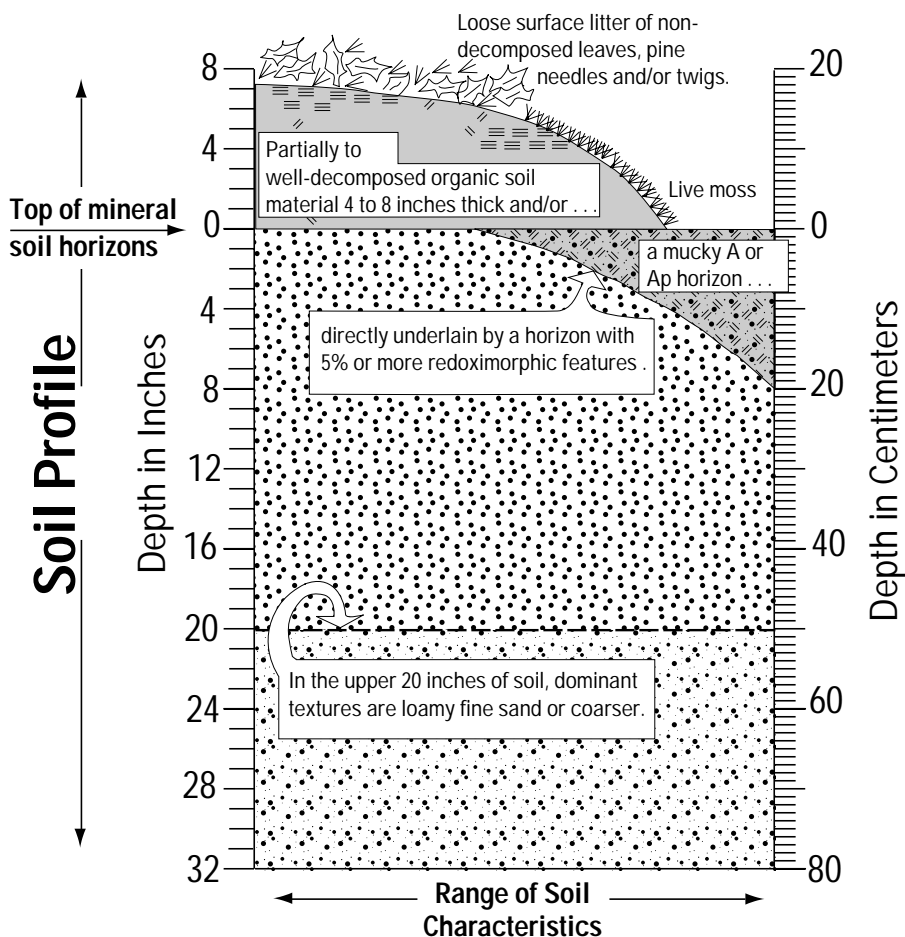


III. Soils that have *aquic conditions* within the upper part of the soil for some period of time in most years; and

G. Do not have a *spodic horizon* and the dominant textures in the upper 20 inches of the soil are *loamy fine sand or coarser* and:

- 1. have a layer 4 to 8 inches thick of *partially to well-decomposed (hemic and/or sapric) organic soil material* and/or a *mucky A or Ap horizon*; and are *directly underlain* by a horizon with 5 percent or more *redoximorphic features*; or**

Hydric Soil Indicator III. G. 1.



Key for Soil Textures

Partially decomposed organic matter	Mucky mineral soil	Dominant textures finer than loamy fine sand
Well decomposed organic matter	Dominant textures loamy fine sand or coarser	Any mineral soil texture

III. Soils that have *aquic conditions* within the upper part of the soil for some period of time in most years; and

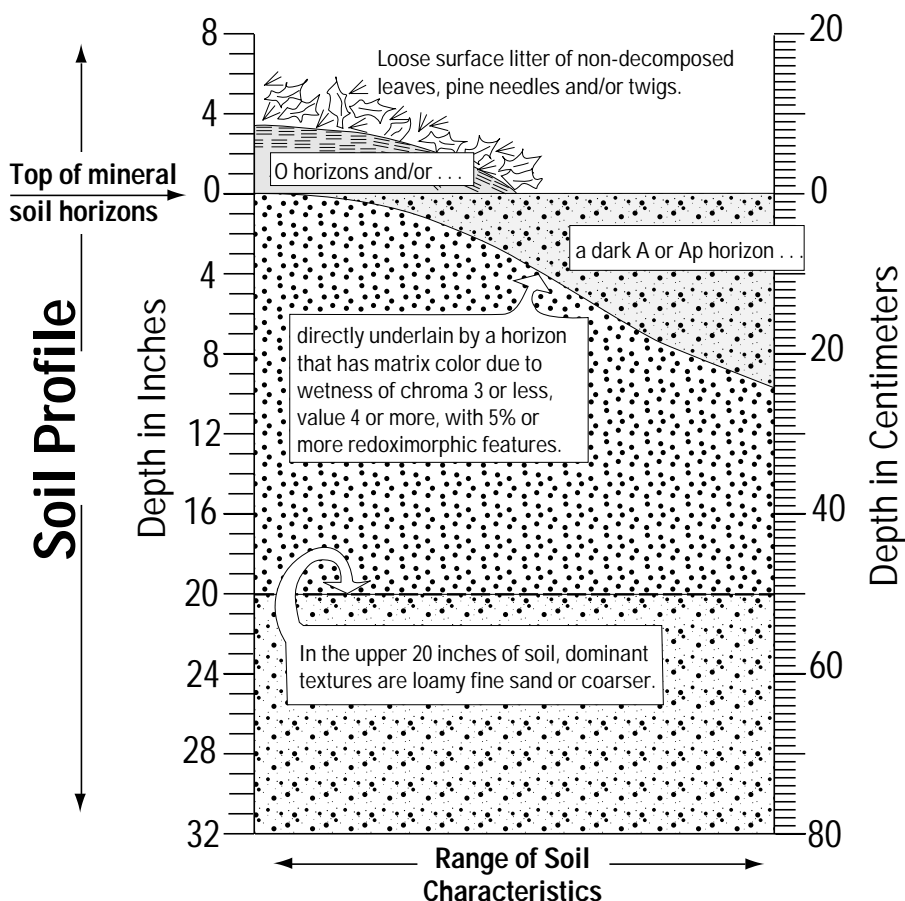
G. Do not have a *spodic horizon* and the dominant textures in the upper 20 inches of the soil are *loamy fine sand or coarser* and:

- 2. within 10 inches of the top of the *mineral soil material* and directly underlying a *dark A* or *Ap horizon* (or, if they are not present, an *O horizon*) is a horizon with a *matrix color* due to wetness of chroma 3 or less, value 4 or more, with 5 percent or more *redoximorphic features*; or**









USER NOTE: Field investigations have documented some situations where the conditions for a hydric soil are present and the matrix chroma directly underlying the *A* or *Ap horizon* is greater than 3. These soil conditions are associated with *groundwater discharge areas*. When making a hydric soil determination in a similar area, professional judgment by a qualified individual is recommended for interpreting the *soil morphologies*.

Hydric Soil Indicator III. G. 2.



Key for Soil Textures

 Partially decomposed organic matter	 Mucky mineral soil	 Dominant textures finer than loamy fine sand
 Well decomposed organic matter	 Dominant textures loamy fine sand or coarser	 Any mineral soil texture

III. Soils that have *aquic conditions* within the upper part of the soil for some period of time in most years; and

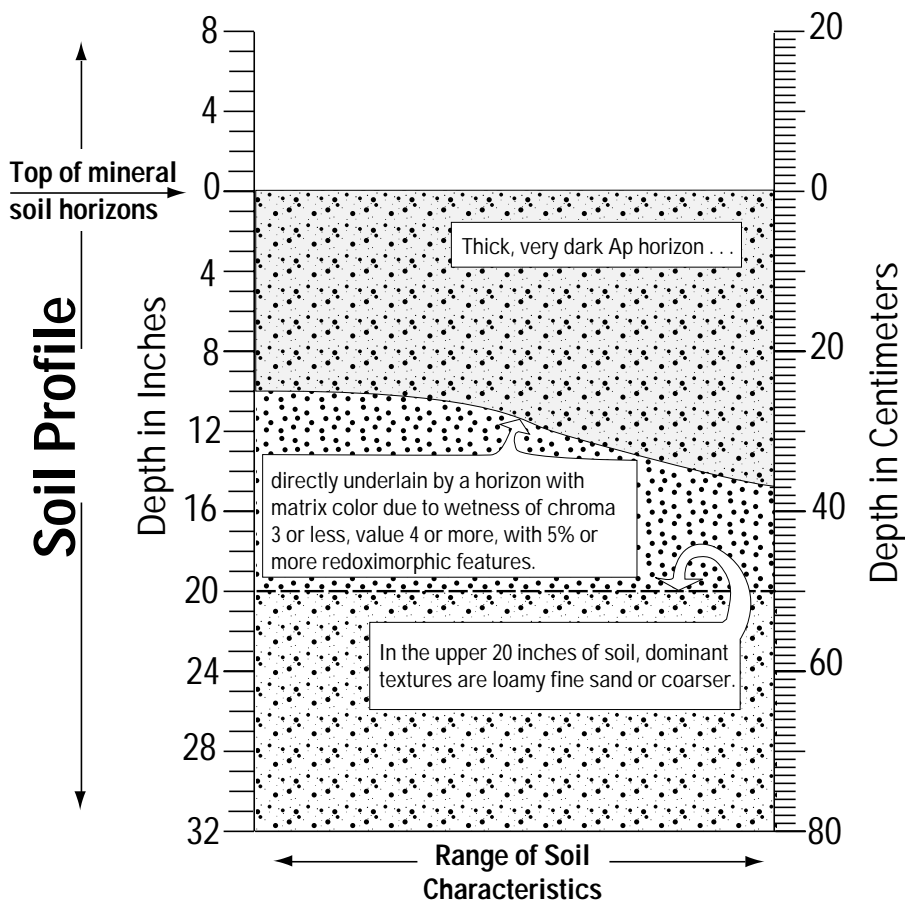
G. Do not have a *spodic horizon* and the dominant textures in the upper 20 inches of the soil are *loamy fine sand or coarser* and:

- 3. within 15 inches of the top of the *mineral soil material* and directly underlying a *thick, very dark Ap horizon* there is a horizon with a *matrix color* due to wetness of chroma 3 or less, value 4 or more, with 5 percent or more *redoximorphic features*.**









USER NOTE: Field investigations have documented some situations where the conditions for a hydric soil are present and the matrix chroma directly underlying the *A* or *Ap horizon* is greater than 3. These soil conditions are associated with *groundwater discharge areas*. When making a hydric soil determination in a similar area, professional judgment by a qualified individual is recommended for interpreting the *soil morphologies*.

Hydric Soil Indicator III. G. 3.



Key for Soil Textures

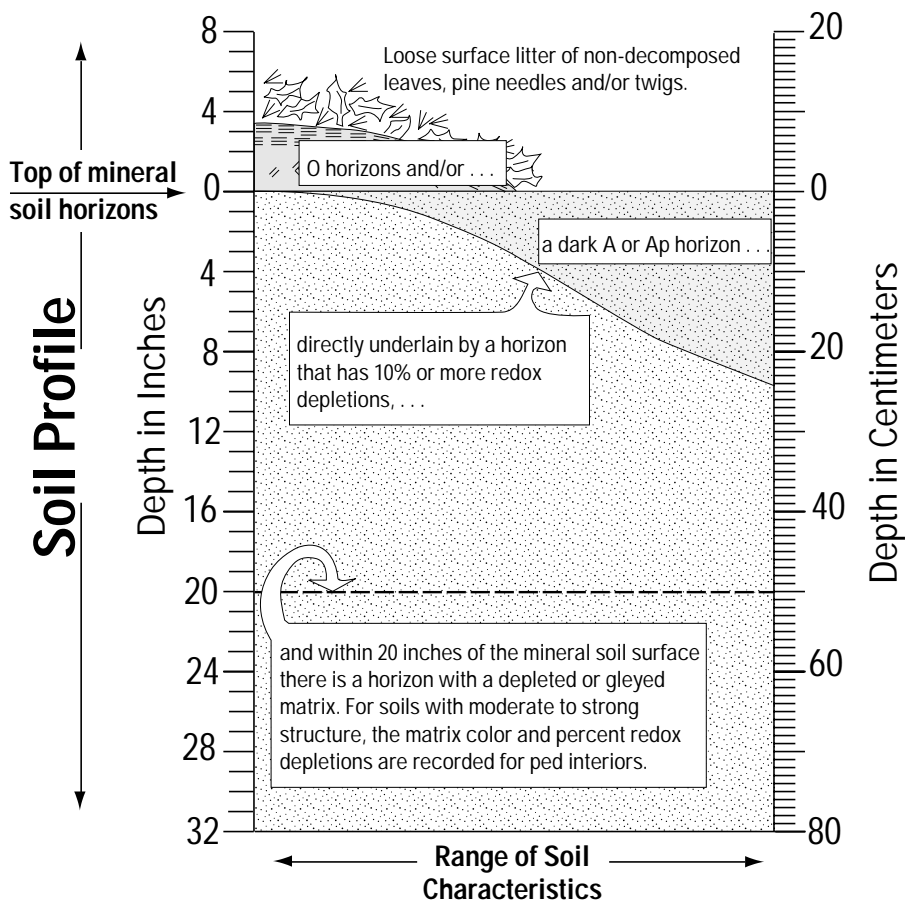
	Partially decomposed organic matter		Mucky mineral soil		Dominant textures finer than loamy fine sand
	Well decomposed organic matter		Dominant textures loamy fine sand or coarser		Any mineral soil texture

III. Soils that have *aquic conditions* within the upper part of the soil for some period of time in most years; and







H. Do not have a *spodic horizon* and the dominant textures in the upper 20 inches of soil are *finer than loamy fine sand*, and

- 1. within 10 inches of the top of the *mineral soil material* and directly underlying a *dark A* or *Ap horizon* (or, if they are not present, an *O horizon*) is a horizon with 10 percent or more *redox depletions*, and within 20 inches of the *mineral soil surface* there is a horizon with a *depleted* or *gleyed matrix* (for soils with *moderate* to *strong structure*, the *matrix color* and percent *redox depletions* are recorded for *ped interiors*); or**

Hydric Soil Indicator III. H. 1.



Key for Soil Textures

 Partially decomposed organic matter	 Mucky mineral soil	 Dominant textures finer than loamy fine sand
 Well decomposed organic matter	 Dominant textures loamy fine sand or coarser	 Any mineral soil texture

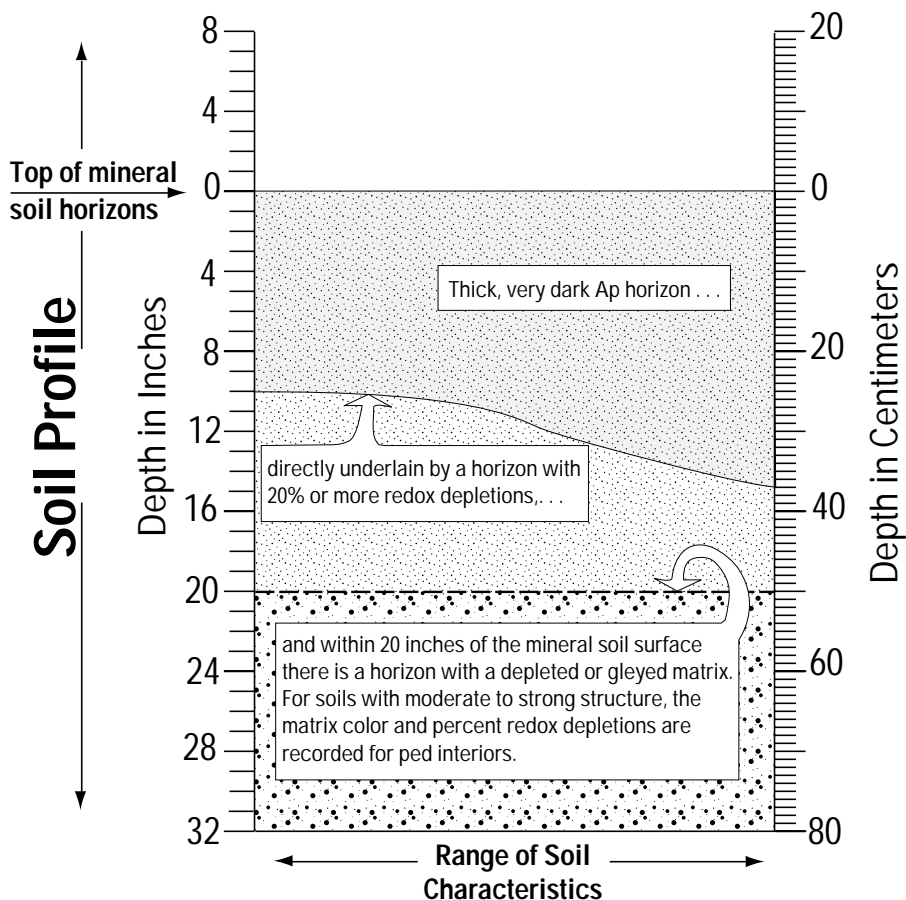
III. Soils that have *aquic conditions* within the upper part of the soil for some period of time in most years; and

H. Do not have a *spodic horizon* and the dominant textures in the upper 20 inches of soil are *finer than loamy fine sand*, and

2. within 15 inches of the top of the *mineral soil material* and directly underlying a *thick, very dark Ap horizon*, is a horizon with either:

a) 20 percent or more *redox depletions* and within 20 inches of the *mineral soil surface* there is a horizon with a *depleted* or *gleyed matrix* (for soils with *moderate to strong structure*, the *matrix color* and percent *redox depletions* are recorded for *ped interiors*); or

Hydric Soil Indicator III. H. 2. a.



Key for Soil Textures

	Partially decomposed organic matter		Mucky mineral soil		Dominant textures finer than loamy fine sand
	Well decomposed organic matter		Dominant textures loamy fine sand or coarser		Any mineral soil texture

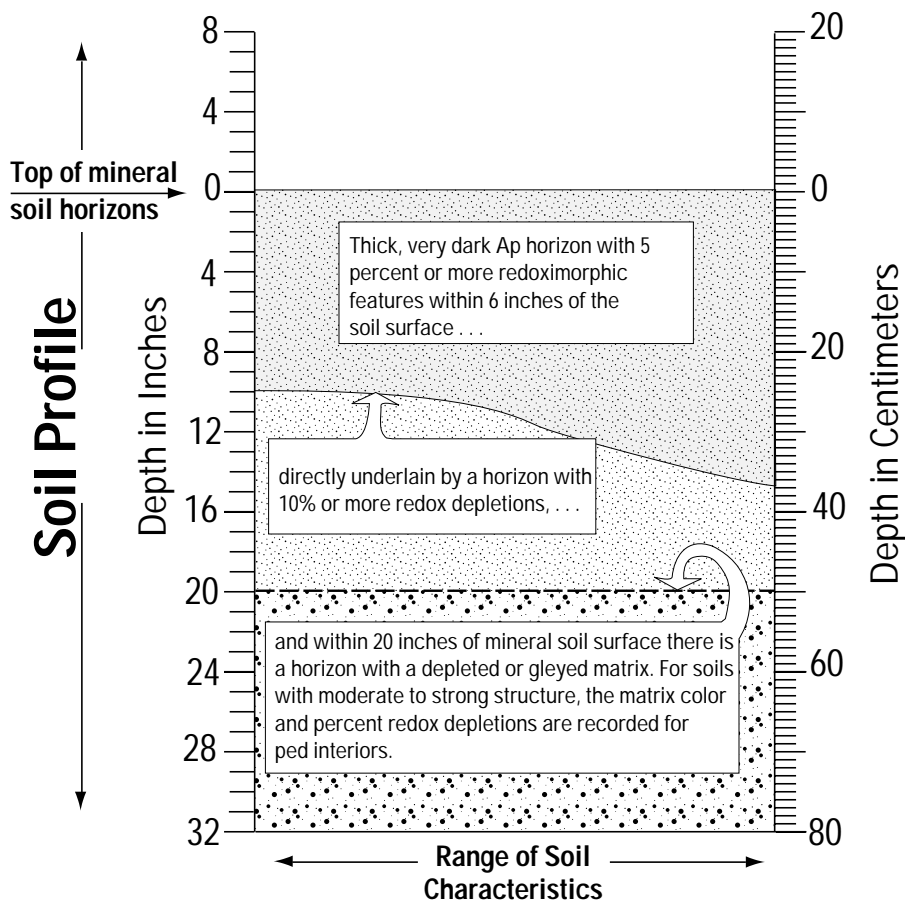
III. Soils that have *aquic conditions* within the upper part of the soil for some period of time in most years; and

H. Do not have a *spodic horizon* and the dominant textures in the upper 20 inches of soil are *finer than loamy fine sand*, and

2. within 15 inches of the top of the *mineral soil material* and directly underlying a *thick, very dark Ap horizon*, is a horizon with:

b) 10 percent or more *redox depletions* and within 20 inches of the *mineral soil surface* there is a horizon with a *depleted* or *gleyed matrix*, and there are 5 percent or more *redoximorphic features* within 6 inches of the top of the *mineral soil material* (for soils with *moderate to strong structure*, the *matrix color* and percent *redox depletions* are recorded for *ped interiors*).

Hydric Soil Indicator III. H. 2. b.



Key for Soil Textures

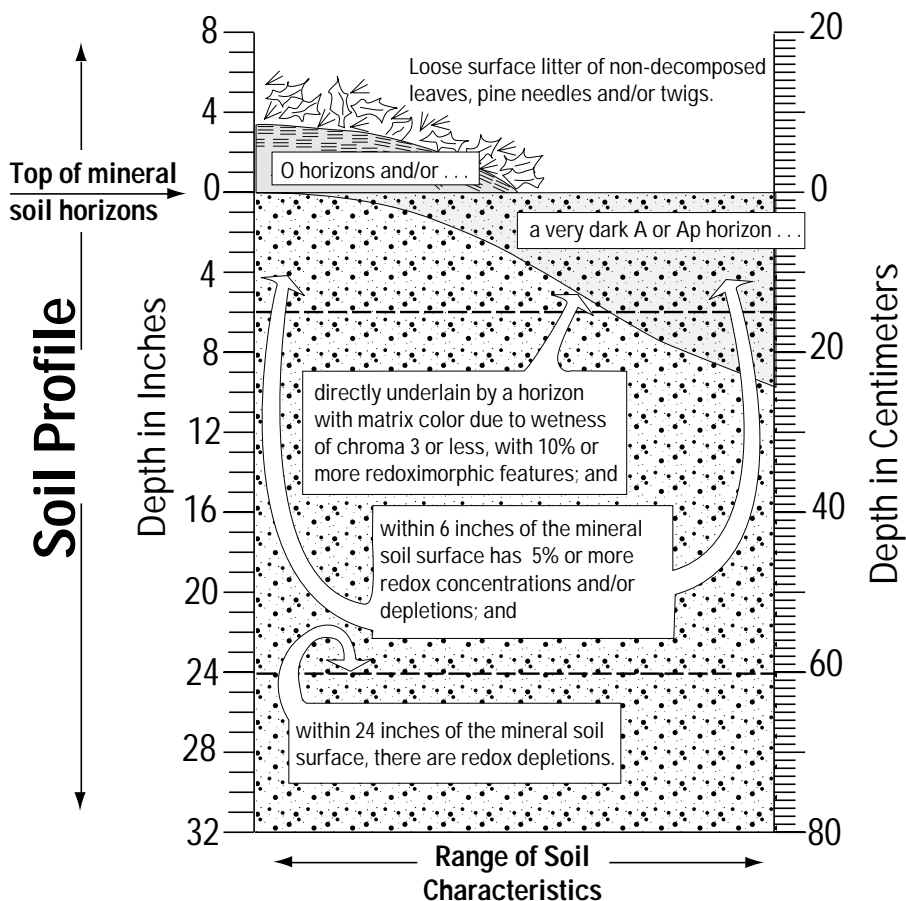
	Partially decomposed organic matter		Mucky mineral soil		Dominant textures finer than loamy fine sand
	Well decomposed organic matter		Dominant textures loamy fine sand or coarser		Any mineral soil texture

III. Soils that have *aquic conditions* within the upper part of the soil for some period of time in most years; and







I. Any soil that has a *very dark A* or *Ap horizon* less than 10 inches thick (or, if they are not present, an *O horizon*) that is *directly underlain* by a horizon with a *matrix color* due to wetness of chroma 3 or less, with 10 percent or more *redoximorphic features*; and within 24 inches of the *mineral soil surface* has *redox depletions*; and within 6 inches of the *mineral soil surface* has:

1. 5 percent or more *redox concentrations* and/or *depletions*, and/or

Hydric Soil Indicator III. I. 1.



Key for Soil Textures

 Partially decomposed organic matter	 Mucky mineral soil	 Dominant textures finer than loamy fine sand
 Well decomposed organic matter	 Dominant textures loamy fine sand or coarser	 Any mineral soil texture

III. Soils that have *aquic conditions* within the upper part of the soil for some period of time in most years; and

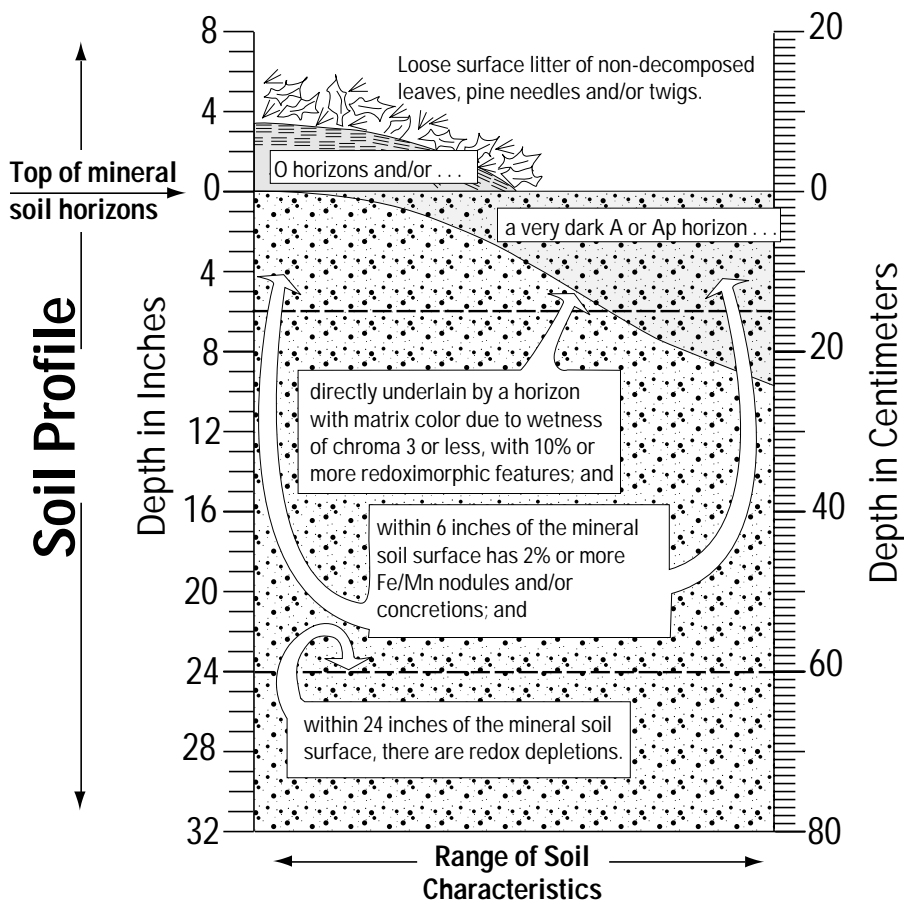
- I. Any soil that has a *very dark A* or *Ap horizon* less than 10 inches thick (or, if they are not present, an *O horizon*) that is *directly underlain* by a horizon with a *matrix color* due to wetness of chroma 3 or less, with 10 percent or more *redoximorphic features*; and within 24 inches of the *mineral soil surface* has *redox depletions*; and within 6 inches of the *mineral soil surface* has:**
 - 2. 2 percent or more *Fe/Mn nodules* and/or *concretions*.**









USER NOTE: Nodules and/or concretions which have formed in place typically have one or more of the following characteristics:

- 1. feel sharp and have rough edges;**
- 2. colors that diffuse into the surrounding matrix;**
- 3. formed within the interior of a soil *ped*.**

Hydric Soil Indicator III. I. 2.



Key for Soil Textures

 Partially decomposed organic matter	 Mucky mineral soil	 Dominant textures finer than loamy fine sand
 Well decomposed organic matter	 Dominant textures loamy fine sand or coarser	 Any mineral soil texture

IV. Problem soil areas, disturbed and/or altered sites.

Not all hydric soils are identified using the morphological indicators contained within this manual. Some soils within the New England Region have developed within mineral *parent materials* that mask or inhibit the development of *soil morphologies*. In other soils, the *parent materials* have been deposited recently, disturbed and/or altered and there has not been sufficient time for morphologies to develop. Problem soil areas recognized in New England include, but are not limited to: soils developed in Triassic red sandstones, carboniferous schists, strongly calcareous sediments, recently deposited alluvial sediments, some soils adjacent to brackish and salt water bodies, and soils within the *cryic temperature regime* of northern New England. We recognize the need to identify the general locations of these unique soils and to develop reliable field indicators for identifying hydric soils within them.

Table of Contents—Appendix

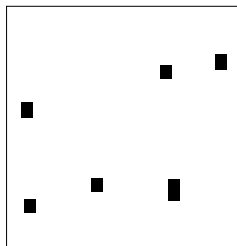
Chart for Estimating Percent Redoximorphic Features	52
Chart for Estimating Size of Redoximorphic Features	53
Table for Estimating Contrast of Redoximorphic Features	54
Chart for Estimating Contrast of Redoximorphic Features	55
Chart for Determining Type of Soil Structure	56
Table for Estimating Grade of Soil Structure	57
Chart for Estimating Size of Granular Structure	58
Chart for Estimating Size of Blocky Structure	59

Source

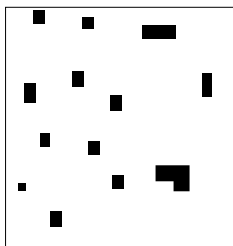
US Department of Agriculture, National Soil Survey Center. 1998. *Field Book for Describing and Sampling Soils*. US Government Printing Office, Washington, D.C.

*compiled by authors for this manual.

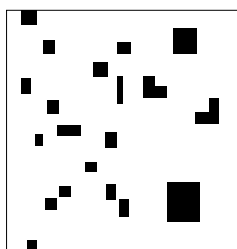
Chart for Estimating Percent Redoximorphic Features



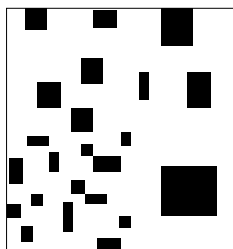
2%



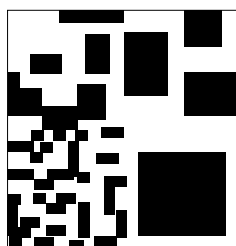
5%



10%



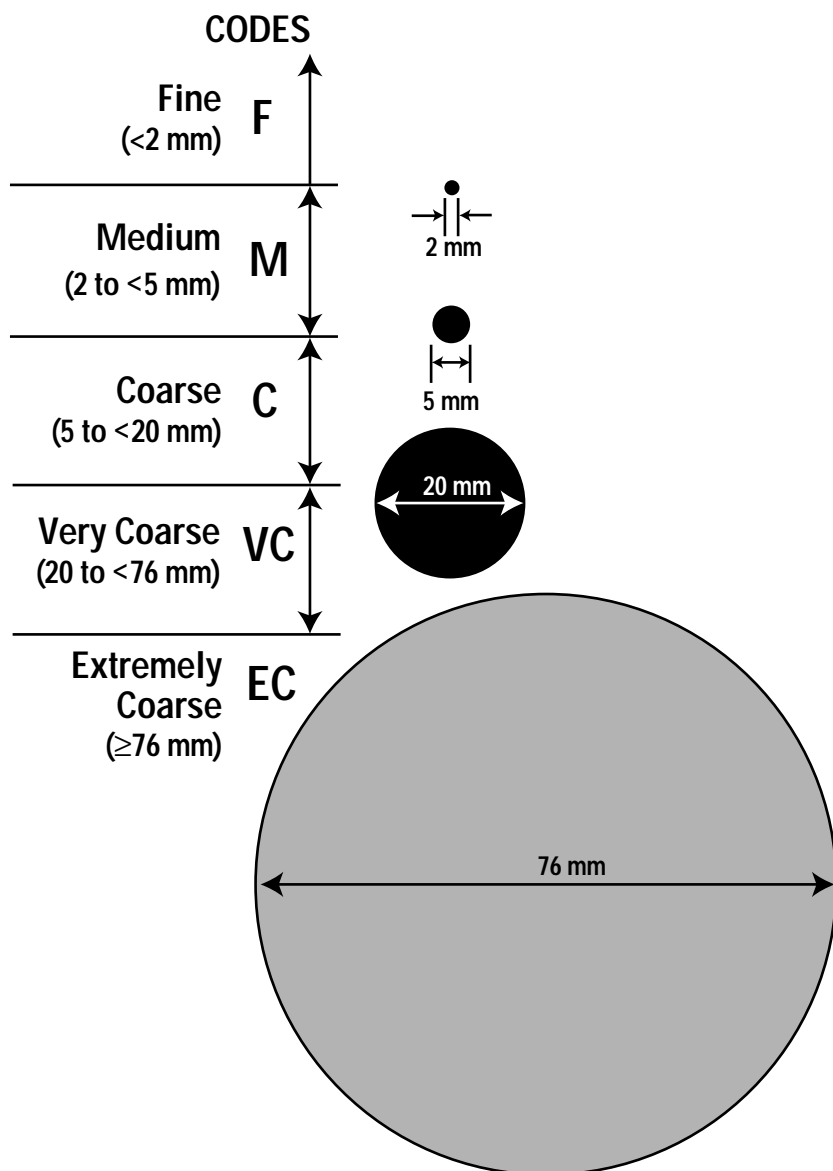
20%



50%

NOTE: Some of the New England Hydric Soil Indicators specify 5, 10, and 20 percent redoximorphic features, and the conventional terms *Few* (<2%) and *Common* (2 to <20%) may not be specific enough.

Chart for Estimating Size Redoximorphic Features



When recording the size of redoximorphic features—

Use length if it's greater than 2 times the width; use width if the length is less than two times the width. Length is the greater of the two dimensions.

Table for Estimating Contrast Redoximorphic Features

Record the color difference between the redoximorphic feature (RMF) and the matrix color. Use this table or the following chart to express the difference.

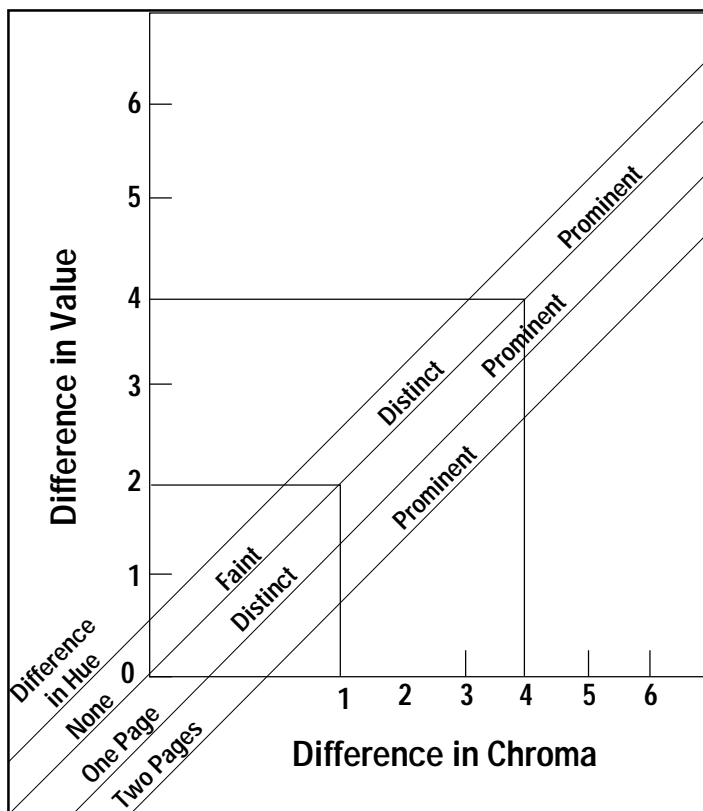
Contrast Class	Code	Difference in Color Between Matrix and Redoximorphic Feature		
		Hue ¹	Value	Chroma
Faint ²	F	same page	0 to ≤ 2	and ≤ 1
Distinct	D	same page	>2 to <4	and <4 or and >1 to <4
		1 page	≤ 2	or ≤ 1
Prominent	P	same page	≥ 4	or ≥ 4
		1 page	>2	or >1
		≥ 2 pages	≥ 0	or ≥ 0

- 1 One Munsell® Color Book page = 2.5 hue units. Table contents compiled from material in or intended by the Soil Survey Manual (Soil Survey Staff, 1993).
- 2 *Faint* also includes RMFs that are similar in color to the matrix that have both low (e.g. ≤ 3) value and chroma, and differ by up to 2.5 units (one page) of hue.

NOTE: The Appendix contains both a table and chart for Estimating Contrast Redoximorphic Features.

Chart for Estimating Contrast Redoximorphic Features

(For Use with Munsell Color Book)



If both redoximorphic feature and matrix have low value or chroma, disregard this chart, and record as Faint (e.g., 10YR 1/1 and 7.5YR 1/1 = Faint)

Chart Directions

- Select the appropriate "Difference in Hue" line ("None" refers to "same page").
- Record greatest contrast of VALUE or CHROMA at HUE line intercept (Faint, Distinct or Prominent).

NOTE: The Appendix contains both a table and chart for Estimating Contrast Redoximorphic Features.

Chart for Determining Type of Soil Structure

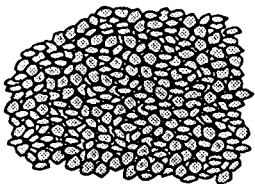



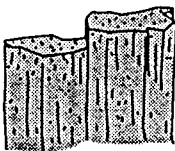
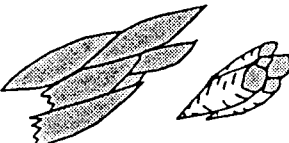
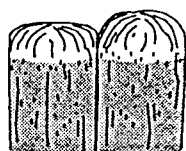
Granular 	Blocky <div>(Subangular) </div> <div>(Angular) </div>	
Platy 	Prismatic 	
Wedge 	Columnar 	

Table for Estimating Grade of Soil Structure

Grade	Code	Criteria
Structureless	0	No discrete units observable in place or in a hand sample.
Weak	1	Units are barely observable in place or in a hand sample.
Moderate	2	Units well-formed and evident in place or in a hand sample.
Strong	3	Units are distinct in place (undisturbed soil), and separate cleanly when disturbed.

Chart for Estimating Size of Granular Structure

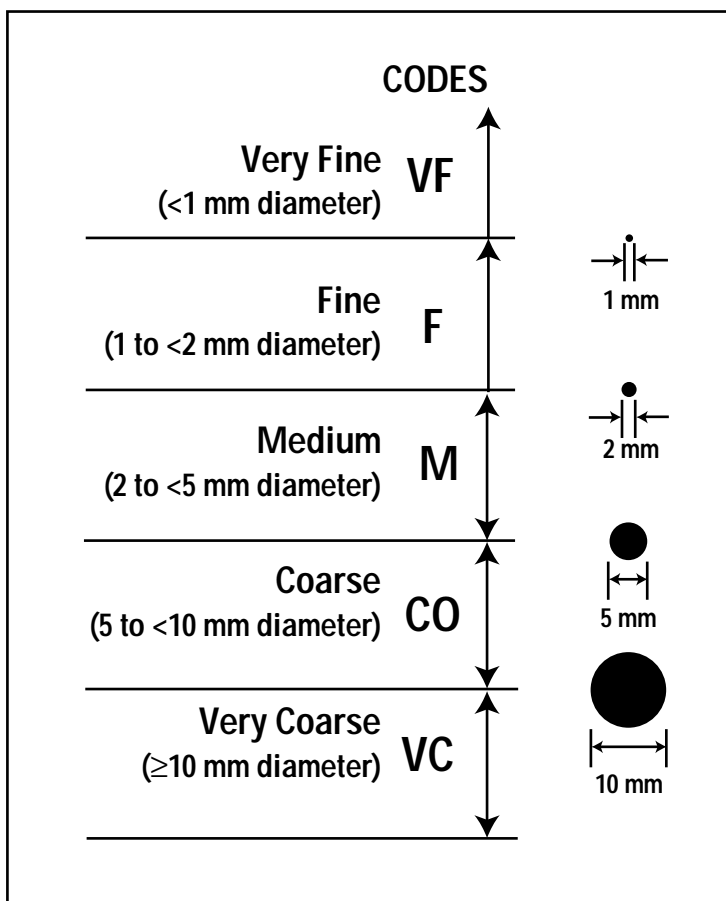
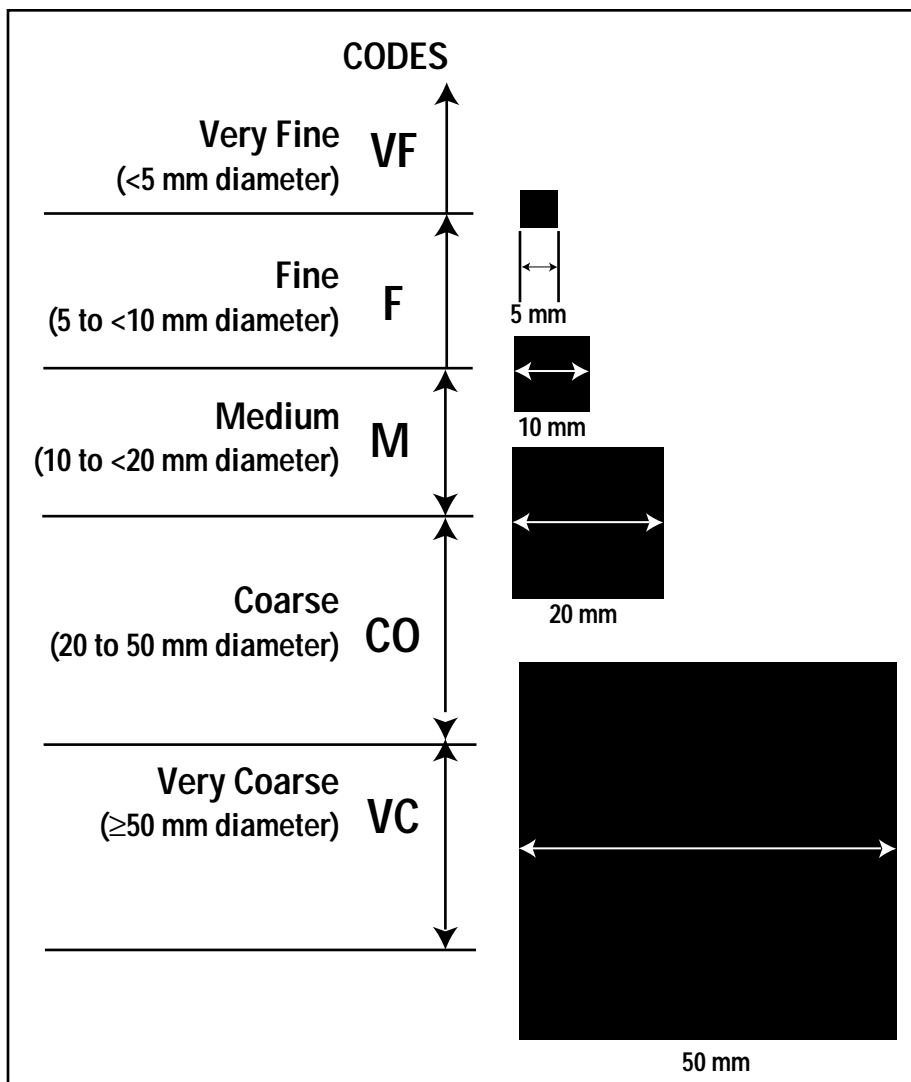


Chart for Estimating Size of Blocky Structure



Glossary Of Terms

A Horizon - *Mineral soil horizons* which have formed at the surface or below an *O horizon* which show an accumulation of humified organic matter intimately mixed with the mineral fraction. See *Soil Survey Manual* (1993) for complete definition.

A or Ap Horizon, Dark* - *A or Ap horizon* that has moist colors with chromas 2 or less and values 3 or less.

A or Ap Horizon, Very Dark* - *A or Ap horizon* that has moist colors with chromas 2 or less and values less than 3.

Albic Horizon - *A mineral soil horizon* from which clay and free iron oxides have been removed or in which the oxides have been segregated to the extent that the color of the horizon is determined primarily by the color of the primary sand and silt particles rather than by the coatings on these particles.

Ap Horizon - An *A horizon* with properties resulting from cultivation, pasturing, or similar kinds of disturbance.

Aquic Conditions - Soils with *aquic conditions* are those which currently experience continuous or periodic saturation and reduction. The presence of these conditions is indicated by *redoximorphic features* and can be verified—except in artificially drained soils—by measuring saturation and reduction. See *Keys to Soil Taxonomy* (1996) for complete discussion.

The three elements of aquic conditions are:

1. **Saturation** - Characterized by zero or positive pressure in the soil-water. Can generally be determined by observing free water in an unlined auger hole.
2. **Reduction** - Can be characterized by direct measurement of redox potentials. The a,a'-dipyridyl test may be used in the field to determine the presence of reduced iron ions.
3. **Redoximorphic features** - Associated with wetness; result from the reduction and oxidation of iron and manganese compounds in the soil after saturation with water and desaturation, respectively.

* Definition has been modified to better reflect the conditions common to New England and may vary from the National definition.

B Horizon - Horizon that forms below an *A*, *E*, or *O* horizon that shows evidence of soil formation, i.e. development of soil color, formation of *soil structure*, etc. See *Soil Survey Manual* (1993) for complete definition.

Bh and Bhs Horizons - *B horizons* with an accumulation of illuvial, amorphous, dispersible organic matter (sesquioxide complexes). The sesquioxide component coats sand and silt particles. The symbol “h” is used in combination with “s” as Bhs if the amount of sesquioxide component is significant but value and chroma of the horizon are 3 or less. These horizon designations are used to identify and describe *spodic horizons*.

Bh or Bhs Horizon, Dark* - *Bh* or *Bhs* horizon that has moist colors with chromas and values of 3 or less.

Bs Horizon - *B horizon* with an accumulation of illuvial, amorphous, dispersible organic matter - sesquioxide complexes if both the organic matter and sesquioxide components are significant, and if either the moist color value or chroma of the horizon is four or more. This horizon designation is often used to identify and describe *spodic horizons*.

Common, Redoximorphic Features - *Redoximorphic features* represent from 2 to 20 percent of the observed surface area.

Crushed and Smoothed Color - A soil color recorded for a moist soil sample that has been broken up, and then lightly compressed and smoothed with one's thumb.

Cryic Temperature Regime - A soil temperature regime that has mean annual soil temperatures of $>0^{\circ}\text{C}$ but $<8^{\circ}\text{C}$. Mean summer soil temperature for saturated mineral soils with *O horizons* is $<6^{\circ}\text{C}$ at 50 cm. See *Keys to Soil Taxonomy* (1996) for complete definition.

Dark A or Ap Horizon* - Refer to *A* or *Ap* Horizon, Dark.

Dark Bh or Bhs Horizon* - Refer to *Bh* or *Bhs* Horizon, Dark.

Depleted Matrix* - A *depleted matrix* refers to the volume of a *soil horizon* or subhorizon from which iron has been removed or transformed by processes of reduction and translocation to create

* Definition has been modified to better reflect the conditions common to New England and may vary from the National definition.

colors of low chroma and high value. *A* and *E* horizons may have low chromas and high values and may therefore be mistaken for a *depleted matrix*; however, they are excluded from the definition. In some places the *depleted matrix* may change color upon exposure to air (*reduced matrix*); this phenomenon is included in the concept of *Depleted Matrix*.

The following combinations of value and chroma identify a *depleted matrix*:

1. Matrix value 4 or more and chroma 1 or less with or without other *redoximorphic features*; or
2. Matrix value 6 or more and chroma 2 or less with or without other *redoximorphic features*; or
3. Matrix value 4 or 5 and chroma 2 with 5 percent or more *redoximorphic features*.

For *matrix color* matching those on the color pages labeled “Gley,” refer to *Gleyed Matrix* definition.

Directly Underlain, Horizon - A *soil horizon* which lies immediately beneath, and is in direct contact with, another *soil horizon*. When such an horizon is required to have specific soil morphological features, those features must be present beginning in the upper part of that horizon.

Distinct, Redoximorphic Feature - A term used to describe the contrast in color between a *redoximorphic feature* and the matrix. Refer to both the Chart and Table for Estimating Contrast of Redoximorphic Features, located in the Appendix.

Dominant Textures in the Upper 20 Inches - Determined by measuring the thickness of the different textural breaks within a 20-inch depth and calculating the greatest cumulative thickness.

E Horizon - An eluvial, *mineral soil horizon* in which the main feature is loss of silicate clay, iron, or aluminum, or some combination of these, leaving a concentration of sand and silt particles. See *Soil Survey Manual* (1993) for complete definition.

Eluvial Horizon - A *soil horizon* that has been formed by the process of eluviation, i.e. *E horizon*.

* Definition has been modified to better reflect the conditions common to New England and may vary from the National definition.

Faint, Redoximorphic Feature - A term used to describe the contrast in color between a *redoximorphic feature* and the matrix. Refer to both the Chart and Table for Estimating Contrast of Redoximorphic Features, located in the Appendix.

Fe/Mn Concretion - A cemented concentration of a chemical compound of iron and manganese that can be removed from the soil intact and that has a crude internal symmetry organized around a point, a line, or a plane.

Fe/Mn Nodule - A cemented concentration of a chemical compound of iron and manganese that can be removed from the soil intact and that has no orderly internal organization.

Few, Redoximorphic Features - *Redoximorphic features* represent less than 2 percent of the observed surface area.

Fibers (Organic) - Pieces of plant tissue in *organic soil material*, excluding live roots. The amount of *fibers* after rubbing (rubbed fiber content) is used to differentiate *fibric*, *hemic* and *sapric organic materials*. See *Keys to Soil Taxonomy* (1996) for complete description.

Fibric Soil Material - Organic matter with a *fiber* content after rubbing of two fifths or more recognizable *fibers* of undecomposed plant remains, excluding live roots. The *soil horizon* notation for fibric soil material is Oi. See *Keys to Soil Taxonomy* (1996) for complete definition.

Finer Than Loamy Fine Sand - Includes USDA Textural classes: loamy very fine sand, all sandy loam textures, loam, silt loam, silt, sandy clay loam, clay loam, sandy clay, silty clay, and clay.

Flooded - A condition in which the *soil surface* is temporarily covered with flowing water from sources such as streams overflowing their banks, runoff from adjacent or surrounding slopes, inflow from high tides, or any combination of sources.

Folist - *Histosols* which are never saturated with water except for a few days following heavy rains. See *Keys to Soil Taxonomy* (1996) for complete definition.

* Definition has been modified to better reflect the conditions common to New England and may vary from the National definition.

Frequently Flooded - A frequency class in which flooding is likely to occur, often under usual weather conditions (more than 50 percent chance in any year, or more than 50 times in 100 years).

Frequently Ponded - A frequency class in which ponding is likely to occur, often under usual weather conditions (more than 50 percent chance in any year, or more than 50 times in 100 years).

Frigid Temperature Regime - A soil temperature regime that is warmer in the summer than a soil with a *cryic regime*, but has mean annual temperatures $<8^{\circ}\text{C}$, and the difference between mean summer and mean winter soil temperatures is $>5^{\circ}\text{C}$ at a depth of 50 cm from the soil surface. See *Keys to Soil Taxonomy* (1996) for complete definition.

Gleyed Matrix* - A *gleyed matrix* has a history of prolonged periods of wetness and refers to the volume of a *soil horizon* or subhorizon where iron has been reduced and removed, or where saturation with stagnant water has preserved a reduced state.

Gley colors include:

1. 10Y, 5GY, 10GY, 10G, 5BG, 10BG, 5B, 10B, or 5PB with value 4 or more and chroma is 1; or
2. 5G with value 4 or more and chroma is 1 or 2; or
3. N with value 4 or more.

In some places the *gleyed matrix* may change color upon exposure to air (*reduced matrix*). This phenomenon is included in the concept of *Gleyed Matrix*.

Groundwater Discharge Areas* - For purposes of this document, these are areas typically at the base of slopes (e.g., footslope or toeslope) where groundwater moves toward the land surface and discharges onto or close to the surface.

Growing Season - The portion of the year when soil temperatures are above biological zero (5°C) at a depth of 50 cm below the *soil surface*.

Hemic Soil Material - Organic matter with a *fiber* content after rubbing ranging from greater than one sixth (by volume) to less than

* Definition has been modified to better reflect the conditions common to New England and may vary from the National definition.

two fifths, excluding live roots. The *soil horizon* notation for hemic soil material is Oe.

Histic Epipedon - A thick organic surface horizon that has either aquic conditions for some time in most years or has been artificially drained. The thickness requirements of a *histic epipedon* depend upon a number of variables (i.e., clay content and source of organic matter) but, in general, are between 8 and 16 inches thick. Refer to *Keys to Soil Taxonomy* (1996) for complete definition.

Histosols - Organic soils that have *organic soil material* in more than half of the upper 80 cm (32 inches), or that are of any thickness if overlying rock or fragmental materials have interstices filled with *organic soil material*. When overlying unconsolidated *mineral soil material*, organic soils are typically greater than 16 inches thick. Refer to *Keys to Soil Taxonomy* (1996) for complete definition.

Humification - The process whereby the carbon of organic residues is transformed and converted to humic substances through biochemical and abiotic processes.

Hydric Soil Criteria (1995) -

1. All *Histosols* except *Folists*, or
2. Soils in Aquic suborders, great groups, or subgroups, Albolls suborder, Aquisalids, Pachic subgroups, or Cumulic subgroups that are:
 - a. somewhat poorly drained with a water table equal to 0.0 feet (ft.) from the surface during the *growing season*, or
 - b. poorly drained or very poorly drained and have either:
 - (1) water table equal to 0.0 ft. during the *growing season* if textures are coarse sand, sand, or fine sand in all layers within 20 inches (in.), or for other soils, or
 - (2) water table at less than or equal to 0.5 ft. from the surface during the *growing season* if permeability is equal to or greater than 6.0 in./hour (h.) in all layers within 20 in., or
 - (3) water table at less than or equal to 1.0 ft. from the surface during the *growing season*, if permeability is less than 6.0 in./h. in any layer within 20 in., or

* Definition has been modified to better reflect the conditions common to New England and may vary from the National definition.

3. Soils that are *frequently ponded* for *long* or *very long* duration during the *growing season*, or
4. Soils that are *frequently flooded* for *long* or *very long* duration during the *growing season*.

Refer to *Federal Register*, February 24, 1995.

Hydric Soil Definition (1994) - A soil that formed under conditions of saturation, flooding, or ponding long enough during the *growing season* to develop anaerobic conditions in the upper part. Refer to *Federal Register*, July 13, 1994.

Loamy Fine Sand or Coarser - Includes USDA Textural Classes: sands and loamy sand textures excluding loamy very fine sand.

Long Duration* - For purposes of this document, a duration class in which inundation for a single event ranges from 2 weeks to 1 month.

Low Chroma Colors - Colors, when using the Munsell Color System, with chromas 2 or less, and values 4 or more.

Many, Redoximorphic Features - *Redoximorphic features* represent 20 percent or more of the observed surface area.

Masses, Soft - *Redox concentrations* that are not hard that are frequently within the matrix and whose shapes are variable. *Soft masses* include features that formerly would have been called “reddish mottles.”

Matrix Color - Dominant soil color (as determined by 50 percent or more with two colors, or the highest percentage with more than two colors).

Mesic Temperature Regime - A soil temperature regime that has mean annual soil temperatures of $\geq 8^{\circ}\text{C}$ but $< 15^{\circ}\text{C}$ and the difference between mean summer and mean winter soil temperatures is more than 5°C at a depth of 50 cm from the *soil surface*. See *Keys to Soil Taxonomy* (1996) for complete definition.

Mineral Soil Horizon - Soil horizon consisting of *mineral soil material* (i.e., A, E, and B horizons).

Mineral Soil Material - Soil horizons or layers comprised mostly of

* Definition has been modified to better reflect the conditions common to New England and may vary from the National definition.

mineral material with a relatively low content of organic matter (less than 12 to 18 percent of organic carbon by dry weight, depending upon the clay content).

Mineral Soil Surface - Typically the top of the uppermost *mineral soil horizon*. An exception may be an area of *organic soil material* buried beneath *mineral soil material*. See *Keys to Soil Taxonomy* (1996) for complete discussion.

Moderate Structure - Well-formed *distinct peds* evident in undisturbed soil. When disturbed, soil material parts into a mixture of whole units, broken units, and material that is not in units.

Mucky - A USDA soil texture modifier (e.g., mucky sand). Mucky modified mineral soil with 0 percent clay has between 5 and 12 percent organic carbon. Mucky modified mineral soil with 60 percent clay has between 11 and 18 percent organic carbon. Soils with an intermediate amount of clay have intermediate amounts of organic carbon.

O Horizon - Soil horizon consisting of *organic soil material*.

Organic Soil Material - Typically has from 12 to 18 percent or more organic carbon by dry weight, depending upon the percent of clay content.

Organic Streaking - Shades of gray to black colors due to organic coatings on soil particles, while adjacent soil particles remain uncoated. Most common in sandy soils, these localized organic coatings are some times referred to as “blotchiness,” and are the result of a fluctuating water table.

Ortstein - A cemented horizon that consists of *spodic materials*.

Oxidized Rhizospheres - A form of *pore lining* found on the surface of, or in the soil material adjacent to, live roots of plants that can transport oxygen to their roots in saturated soils.

Parent Material - The unconsolidated and more or less chemically weathered mineral or organic matter from which the *solum* of soils is developed by pedogenic processes.

* Definition has been modified to better reflect the conditions common to New England and may vary from the National definition.

Partially Decomposed Organic Soil Material - Refer to *hemic soil material*.

Ped - A unit of soil structure such as a block, column, granule, plate, or prism, formed by natural processes (in contrast with a **clod**, which is formed artificially).

Ped Interiors - The interior of an individual natural soil aggregate such as a block or a plate.

Pedon - A three-dimensional body of soil with lateral dimensions large enough to permit the study of horizon shapes and relations. See *Glossary of Soil Science Terms* (1997) for a complete definition.

Polyvalue Colors* - A soil feature resulting from a fluctuating water table where translocated organic matter unevenly covers the soil material, forming a diffuse splotchy pattern. Organic streaking is a polyvalue color feature.

Ponded - A condition in which water stands in a closed depression. The water is removed only by percolation, evaporation and/or transpiration.

Pore Linings - Zones of accumulation that may be either coatings on a pore surface or impregnations of the matrix adjacent to the pore. See Vepraskas (1996) for complete discussion.

Prominent, Redoximorphic Feature- A term used to describe the contrast in color between a *redoximorphic feature* and the matrix. Refer to both the Chart and Table for Estimating Contrast of Redoximorphic Features, located in the Appendix.

Redox Concentrations - Bodies of apparent accumulation of Fe/Mn oxides. *Redox concentrations* include *soft masses*, *pore linings*, nodules, and concretions. See Vepraskas (1996) for complete discussion.

Redox Depletions - Bodies of low chroma (2 or less) having value 4 or more where Fe-Mn oxides have been stripped or where both Fe-Mn oxides and clay have been stripped. *Redox depletions* include features that would formerly have been called “gray mottles.” See Vepraskas (1996) for more complete discussion.

* Definition has been modified to better reflect the conditions common to New England and may vary from the National definition.

Redoximorphic Features - Features formed by the processes of reduction, translocation, and/or oxidation of Fe and Mn oxides. Formerly called mottles and *low chroma colors*. *Redoximorphic features* include: *soft masses*, *pore linings*, nodules and concretions, iron depletions, clay depletions, *depleted matrices*, *gleyed matrices*, and *reduced matrices*. See Vepraskas (1996) for more complete discussion.

Redoximorphic Features, Abundance of - The percent of the surface area covered by *redoximorphic features*. Refer to Chart for Estimating Percent Redoximorphic Features, located in the Appendix.

Redoximorphic Features, Contrast of - The contrast in color between the *redoximorphic feature* and the *matrix color*. Refer to both the Chart and the Table for Estimating Contrast of Redoximorphic Features, located in the Appendix.

Redoximorphic Features, Size of - The size of *redoximorphic features* (fine, medium, coarse, very coarse, and extremely coarse). Refer to the Chart for Estimating Size of Redoximorphic Features, located in the Appendix.

Reduced Matrix - Soil matrices that have low chroma and high value, but whose color changes in hue or chroma when exposed to air. See Vepraskas (1996) for complete discussion.

Sapric Soil Material - Organic matter that has a *fiber* content after rubbing of less than one sixth (by volume), excluding live roots. The *soil horizon* notation for *sapric soil material* is Oa.

Shallow E Horizon - An *E horizon* which does not extend below a depth of 6 inches. Measurement is made from the top of the *mineral soil material*.

Soil - Natural bodies, made up of mineral and organic material, that cover much of the earth's surface. Containing living matter and can support vegetation out-of-doors, and have in places been changed by human activity. See *Keys to Soil Taxonomy* (1996) for complete discussion.

* Definition has been modified to better reflect the conditions common to New England and may vary from the National definition.

Soil Horizon - A layer of soil or soil material approximately parallel to the land surface and differing from adjacent genetically related layers in physical, chemical, and biological properties or characteristics such as color, structure, texture, consistence, degree of acidity, etc.

Soil Morphology - The physical constitution of a soil profile as exhibited by the kinds, thicknesses, and arrangements of the horizons in the profile, and by the texture, structure, consistence, and porosity of each horizon.

Soil Structure - The combination or arrangement of primary soil particles into secondary units or *peds*. The secondary units are characterized on the basis of size, shape, and grade (degree of distinctness).

Soil Surface* - For purposes of this document, the reference point (0) for depth measurements varies depending upon one of two soil conditions:

1. For organic soils (*Histosols*) and soils with a thick, organic surface horizon greater than 8 inches (*histic epipedon*), the point of measurement is the top of the part of the *O horizon* that is at least slightly decomposed. Fresh leaf or needle fall that has not undergone observable decomposition is excluded from soil and may be described separately.
2. For mineral soils lacking a thick, organic surface horizon (*histic epipedon*), the surface is the top of the *mineral soil horizons*.

Solum - A set of horizons that are related through the same cycle of pedogenic processes; the *O*, *A*, *E*, and *B horizons*.

Some Period of Time - In the New England Region this is about two continuous weeks or more during the *growing season*.

Spodic Horizon - An illuvial layer that is 2.5 cm (1 in.) or more thick, is not part of an *Ap horizon*, and contains 85 percent or more *spodic materials*. For field conditions where an *albic (E) horizon* extends horizontally through 50 percent or more of each *pedon*, the colors directly under the *albic horizon* are as follows:

1. a hue 5YR or redder (i.e., 2.5YR, etc.); or

* Definition has been modified to better reflect the conditions common to New England and may vary from the National definition.

2. a hue of 7.5YR, color value 5 or less and chroma 4 or less (a hue of 7.5YR with value 5 and chroma 6 does not qualify without additional chemical properties); or
3. a hue of 10YR or neutral and color value and chroma 2 or less; or
4. a color of 10YR 3/1.

See *Keys to Soil Taxonomy* (1996) for complete definition.

It is important to note that spodic colors are for moist conditions and the samples are *crushed and smoothed* to even out the color pattern.

Spodic Materials - *Mineral soil materials* that are dominated by illuvial active amorphous materials composed of organic matter and aluminum with or without iron. See *Keys to Soil Taxonomy* (1996) for complete definition.

Strongly Developed Oxidized Rhizospheres - *Oxidized rhizospheres* with colors that diffuse into the surrounding soil matrix, as opposed to weakly developed *oxidized rhizospheres* that only coat the surface of live roots.

Strong Structure - *Peds* are *distinct* in undisturbed soil. They separate cleanly when soil is disturbed, and the soil material separates mainly into whole units when removed.

Subsoil - Technically, the *B horizons*; roughly, the part of the *solum* below plow depth.

Substratum - Any layer lying beneath the *solum* (*O, A, E, and B horizons*); includes C and R layers.

Sulfidic Materials - Contain oxidizable sulfur compounds and may be either *mineral* or *organic soil material*. *Sulfidic materials* accumulate as a soil or sediment which is saturated for prolonged periods of time. *Sulfidic materials* most commonly accumulate in coastal marshes, but they may occur in freshwater marshes if there is sulfur in the water. Presence of hydrogen sulfide gas is a field indicator for identifying *sulfidic materials* in the field and is detected as a rotten egg smell. See *Keys to Soil Taxonomy* (1996) for a complete definition.

* Definition has been modified to better reflect the conditions common to New England and may vary from the National definition.

Thick, A and Ap Horizons - For the purposes of this manual, *thick* means greater than 10 inches and less than 15 inches.

Upper Part of the Soil - That portion of the soil that supports the majority of plant roots. In general, in wetlands this zone is limited to the upper 30 cm (12 inches).

Very Dark A or Ap Horizon* - Refer to *A* or *Ap* Horizon, *Very Dark*.

Very Long Duration - This is a duration class in which inundation for a single event is greater than 1 month.

Very Thick* - For the purposes of this manual, *very thick* means greater than 15 inches and less than 20 inches and is used in context with *A* and *Ap* horizons.

Well-Decomposed Organic Soil Material - Refers to *sapric soil material*.

Sources

Glossary of Soil Science Terms. 1997. Soil Science Society of America. Madison, WI.

US Department of Agriculture, Soil Survey Staff. 1996. *Keys to Soil Taxonomy*, Seventh Edition. US Government Printing Office, Washington, DC.

US Department of Agriculture, Soil Survey Division Staff. 1993. *Soil Survey Manual*. USDA Agricultural Handbook 18. US Government Printing Office, Washington, DC.

Vepraskas, M.J. 1996. *Redoximorphic Features for Identifying Aquic Conditions*. Technical Bulletin 301. North Carolina Ag. Research Service, North Carolina State University, Raleigh, NC.

* Definition has been modified to better reflect the conditions common to New England and may vary from the National definition.